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Welcome!



BUILDING A PC may seem complicated, but in reality it's something anyone with a reasonable-sized table, a screwdriver and some enthusiasm can do.

If you caught our previous issue, you'll already have all the information you need to choose the right components for your computer. This month, starting on page 102, we show you how to put it all together, from building basics to putting the finishing touches to your custom-made PC. Even if you don't have a copy of *Shopper 327* to hand, our recommended systems on page 117 will show you the parts you need to build a Budget, Mid-range or High-end system.

If you'd rather leave your PC building to the professionals, we've got you covered here, too. Our group test of £500 PCs – or £600 with a monitor – shows you don't have to spend a fortune to get a powerful and upgradable system. Find your perfect ready-made computer from page 78.

Having a car accident is bad enough without having to argue with another

driver and insurance companies about who was at fault. There's also the worry that criminals will try to scam you out of your hard-earned no-claims bonus by deliberately making you crash into the back of their car. It's possible to protect yourself, however, with a dashboard camera. This will record your driving and any mishaps, and some models will stamp the video with your location, providing you with highly useful evidence in any disputes and a shield against insurance fraud. See which model is best for you from page 92.

You may have noticed that there's an election on the way. We at *Computer Shopper* are politically neutral yet fervent believers in democracy, which is why we feel everyone, Russell Brand included, should get out and vote. But why do we persist in the archaic practice of stuffing bits of paper in boxes at village halls instead of simply voting online? As you've probably guessed, it's not as easy as all that. Find out why in our e-election special (geddit?) on page 118.

Chris Fynamore, Editor
chris@computershopper.co.uk

MEET
THE
TEAM

QUESTION OF THE MONTH

MPs have all been issued iPads, but what technological help do you think they should really have?



Chris Fynamore

“Satnavs to help them find their constituencies”



David Ludlow

“Explosive sci-fi collars so they have to stay in parliament for important votes”



Katharine Byrne

“Ultra-efficient smart duck-house heating systems to burnish their green credentials”



Richard Easton

“Accounting software to help them pay the relatives they employ”



Seth Barton

“Automated hourly texts to remind the government how few people actually voted for them”



Tom Morgan

“Logan's Run-style crystals embedded in their hands to remind MPs to retire before they become too right-wing”



Michael Passingham

“A Tesco Hudl so they can see how the other half lives”

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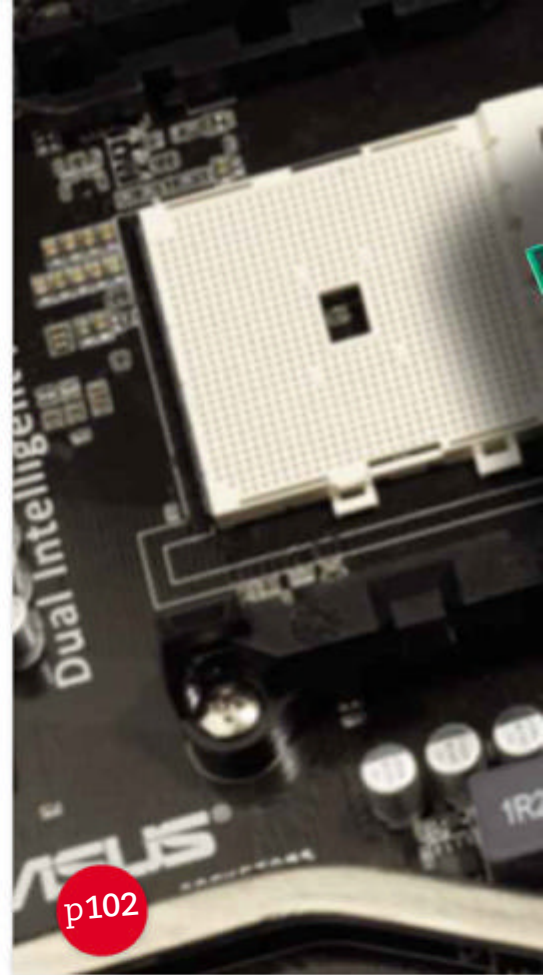
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Contents



Regulars

6 Letters

Your regular missives of wit and wisdom

10 Under Development

Newer is always better, right? Not when your favourite personal organiser program was written for Windows 3.1 and has yet to be bettered, says **David Robinson**

12 Cybercop

How much privacy are we willing to give away for the sake of convenience? Now that smart TVs can listen to every word we say, it's time to take stock, says cyberpoliceman **Gordon Holmes**

14 Rants & Raves

MacBooks, Barbie dolls and bargain hunting – no matter the subject matter, there's always something for the *Shopper* team to get fired up about

146 Zygote

Why is your robot vacuum trying to eat you? There could be any number of reasons, but maybe it's because your smartphone smells of prawns, says the enigmatic **Zygote**

News

16 Newsfile

Our monthly round-up of the latest events in the world of technology

22 InDepth

We investigate whether the new MacBook is just a glorified netbook, and tell you everything you need to know about BT's new 4G mobile network

Features

102 Build a PC

In last month's issue we tested all the component parts you need to build your perfect computer. This month our experienced system builders show you how to put them all together to make a professionally built PC

118 Election 2015

Believe it or not, the way we vote has barely changed since the 19th century. Is it time to move things on and introduce online voting?

Simon Handby investigates



Learn

126 Create a home inventory spreadsheet

129 How to restore a Windows 8 PC or laptop to its factory settings

130 Use Ninite to set up a new PC's software

132 Business Help

Our resident expert answers those persistent software queries

134 Helpfile

Step this way for all your hardware and Windows problems

136 Advanced Projects

In the first of a two-part guide, **Clive Webster** shows you how to build your own home surveillance system with IP cameras, some free software and an old PC

139 App Creative

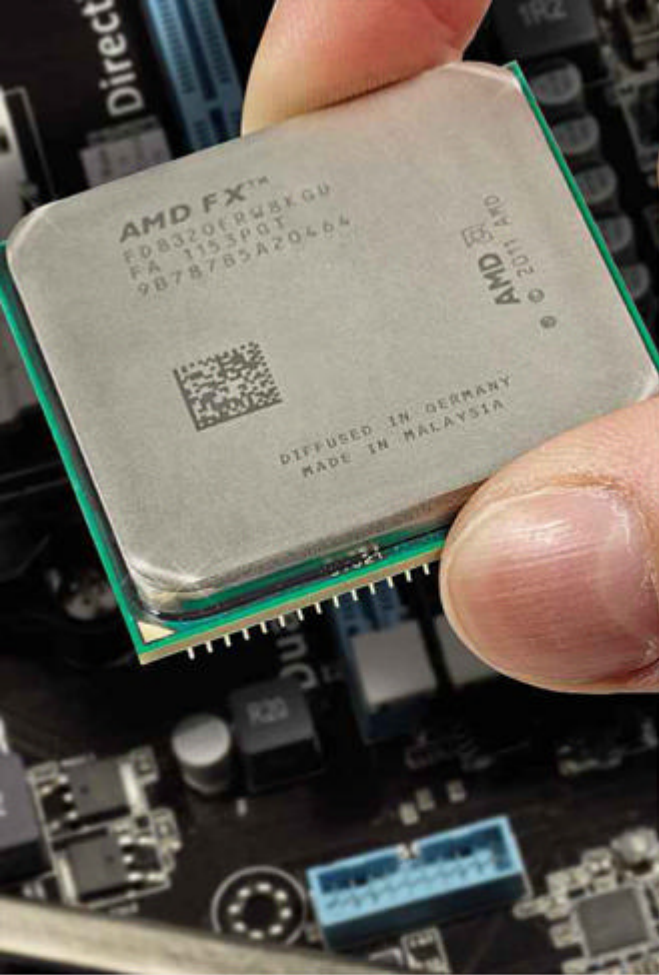
With a tablet, some free software and **Ben Pitt's** expertise, you can unleash your inner artist and create stunning 3D sculptures with swipes of your finger

143 Multimedia Expert

With some torches and a camera set to long exposure, you can create beautiful images that turn your concept of time upside down.

Ben Pitt brings you a guide to light painting





Reviews

26 This month's hot product

The compact Alienware 13 is a powerful gaming laptop, and the optional Graphics Amplifier lets you pair the laptop with a desktop graphics card



28 PCs & Laptops

At just £180 with a year's worth of Microsoft's Office 365 thrown in, HP's Stream 11 is an ultra-portable laptop bargain

34 Handhelds

Dell's Venue 8 7840 tablet has a gorgeous screen and a clever depth-sensing camera that lets you create some great special effects

40 Photography

With incredible burst shooting speeds, the NX1 is Samsung's best digital camera yet

42 Displays

Acer's S277HK monitor crams in 3,840x2,160 pixels to produce excellent image quality

46 Home Cinema

Samsung's UE65JS9000 is the first TV we've seen with support for HDR video, making for incredibly vibrant colours and bright images

50 Audio

The Philips SW750M is a multi-room speaker designed to be used with Spotify Connect

53 Video

The NZXT Doko makes it a cinch to stream your PC's display to a TV in another room

54 Printers & Scanners

Low print costs and a capable scanner make Canon's Maxify MB5050 a good-value MFP

56 Storage

A new processor gives the Synology DiskStation DS215j a welcome speed boost

58 Networks

Draytek's Vigor 2760Vn can handle VoIP calls as well as ADSL and VDSL connections

59 Components

Gigabyte's new LGA1150 motherboard is ideal if you want to build a reliable, powerful system

60 Software

An update to Propellerhead's Reason will be music to your ears if you make your own songs

62 Games

We find out if Homeworld Remastered can still impress, 16 years after the original game

64 Best Buys

Looking for the best kit we've reviewed recently? It's all in our Best Buys section

72 How We Test

Our comprehensive tests and ratings explained

Group Tests

78 £500 PCs

If you'd rather leave your PC build to the professionals, never fear: this month we've reviewed nine excellent systems with powerful processors, fast graphics cards and room for expansion, all for just £500, or £600 with a Full HD monitor



92 Dashboard cameras

Dashcams are designed to record everything that happens on the road, and can provide valuable evidence in the case of an accident to prevent insurance fraud. We've rounded up the best dashboard cameras and apps to help you find the best way to protect yourself when driving



74 Your software



Lost a valuable photo? GetBack Photo from Ashampoo recovers your lost snaps quickly, and it's free for Computer Shopper readers.

Letters


Is there anything you can rely on these days, when components break, kids bypass their parents' security, Microsoft abandons its own tech and even *Shopper* writes instructions for hacking? It's enough to drive a man to poetry

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THE PERFECT FILTER

 The microfilter separating my phone and broadband connections broke, probably due to a lightning surge affecting the phone line. After looking for information about these filters online, I discovered a minefield of conflicting reviews about how certain brands improve or degrade broadband speeds. Examining the circuit of the filter, I found that the broadband circuit goes straight through the filter, and that it's the phone circuit that is actually filtered.

I therefore made the 'perfect' broadband filter by prising open an old microfilter and snipping out all the components to give a straight-through connection for the broadband circuit. Obviously the phone couldn't be used with this arrangement but it allowed me to test broadband speeds knowing the result was not affected by the filter.

Now the interesting part. I then tried making broadband speed measurements with the several brands of microfilter I had available. All the speed measurements were similar to the reference filter I had made. In fact, the simplest filter containing only a coil and capacitor was as good as the more complicated and expensive types.


No doubt better-quality microfilters would be more reliable in the long term, but there seems to be little difference between working filters. Perhaps microfilters are something you could test and review in *Computer Shopper*? Measuring their resilience to lightning surges on the phone line might be more informative than broadband speed.

Steve Byatt

Microfilters are essentially low-pass filters that are designed to prevent the lower-frequency signals of normal voice telephone services from interfering with broadband signals. Your microfilters may well have been affected by a lightning strike, but the components inside are also prone to failure over time even without adverse weather conditions.

As you've noted, the brand of microfilter doesn't seem to make much of a difference, so if you find you're suffering from broadband disconnections, you may as well just replace your microfilters with cheap models (you can get them for £1.20 each from cpc.farnell.com).

IRRESPONSIBLE FEATURE

 On the day that the BBC ran a news story entitled "Dozens arrested in cybercrime 'strike week'" I received *Shopper* 327, which includes an article on computer hacking. The first part gives a good overview of the motivations and methods of hackers, as well as the threats their activities pose and the damage they can do. However, the second part of article, 'How to break in', describes in detail how to gain illegal access to another computer by creating an infected Word document attached to an email sent to the attacked computer.

Admittedly, there are several warnings that such activity is illegal and the article suggests using two of one's own PCs or two virtual machines. However, it still seems irresponsible for a reputable computer magazine like yours to be publishing such detailed instructions of how to carry out a hacking attack. They could be misused by 'anyone with a modicum of computer knowledge' to launch an attack against a bad employer, an ex-partner or someone else they may have a grudge against. Do you really want to encourage such grief-making and illegal activity?

On the whole I find *Computer Shopper* an excellent magazine and the latest issue contains lots of reviews of new PCs, devices, hardware and software. Please stick to what your title implies and not make life easier for would-be hackers whose activities can only cause grief to the rest of us.


Hugh Gorton



↑ Our guide to hacking will hopefully protect you from both real and stereotypical hackers

We appreciate your concerns. All the information about how to hack is freely available online, however, and we feel it is vital to show readers how easy it is to hack into systems, so they can see how important it is to keep their system security up to date.

SECURITY CURE

 In an answer to a letter 'The Human Cybercop' (*Shopper* 327) you suggest that "all you can really do is use strong passwords and not reuse them across your various online services". While I can see your logic, passwords can only be strong if they are unmemorable. Accordingly, strong passwords can only be remembered with some sort of aid to link each strong password to a particular site.

"Use a password manager program," I hear you say. And how does that work after a hard disk failure? Don't tell me, you have never had one. There must be a better way.

Colin Reeves

For most online services, the most secure passwords are indeed a pain to remember, being a jumble of letters and numbers. You could use an online password manager, such as lastpass.com, as this will be immune from hard disk failure. However, some people worry about LastPass itself being hacked, which defeats the object.


One way is to use a password manager such as KeePass from keepass.info. This encrypts your passwords in a single local database file, which you can then keep



Microfilters fail over time, but replacements are easily available and very cheap

backed up. You should always keep a backup of your hard disk in any case.

STICKY SITUATION

 Thanks for the article (*Shopper 327*) about how youngsters are using or could potentially use various tricks to bypass restrictions on broadband connections.


I have set up restrictions on our home network, which is great for the computers and tablets that can only use Wi-Fi, but if you turn off Wi-Fi on a phone and use 3G/4G, I understand you can pretty much access whatever you want. Should we be making sure our youngsters aren't doing this, given that most phone packages give you a fair bit of data?

I haven't tried this trick but a friend told me you can access a nefarious website over 3G/4G that your ISP won't let you access, switch back to Wi-Fi and the site will remain accessible as you have already connected and bypassed the filter. Food for thought?

Nik Higham

A phone's 3G/4G connection has nothing to do with your own Wi-Fi, so any filters you have on your home broadband connection or router will have no effect. However, by default any nefarious content will be blocked by the mobile networks unless the user asks them otherwise, and they will need to be over 18 to do so. The blocked web page may remain on the device's screen once the user switches back from a mobile data connection to Wi-Fi, but as the domain will be blocked, they won't be able to access any other parts of the site.

SCRAPPING THE SURFACE

 I would like to share my views and also ask a few questions about the Microsoft Surface 2.

I didn't want to go down the Apple iPad route so I thought I would get a Surface 2 as it was advertised as a laptop and tablet with Office as well. Great, I thought, a machine to do most things. How wrong I was.

First, my printer does not work with the Surface 2. I spent hours on the phone to the Microsoft helpdesk but to no avail. It works on Windows 7 and 8.1 but not 8.1 RT. Second: BT Sport works on Windows 7 and 8.1 but not on 8.1 RT. There are only apps for Apple and Google Play and none in the Microsoft

Store. Go to BT and you're told to download Microsoft Silverlight, only to be told it's not compatible with RT. You would think it would be compatible as it's a Microsoft technology, but after an online chat to those nice people at the Surface helpline I was again told no.

It's a shame Microsoft doesn't allow Google Play apps, as this would open up a whole new world – there seem to be a lot more apps on Apple and Google Play. I would expect Microsoft to sell a lot more machines if Google Play was available, but alas I didn't realise this until I'd purchased the Surface.

The actual machine is good, responsive, stable and expandable and has a responsive keyboard. The main question I have is whether I will be able to upgrade to Windows 10 as I can't find any answers to this for the RT operating software. Can you help?


Gary Pitman

We're afraid the news is not good. Microsoft's marketing for Windows RT was a bit of a disaster, as the company implied that the tablet had a full Windows Desktop but didn't make it particularly clear that normal Windows applications wouldn't run on it. This is why it won't work with your printer – unless your printer manufacturer decides to write a driver specifically for Windows RT, you're out of luck. There are some apps, such as ThinPrint Cloud Printer, that will print to a printer connected to another PC over the internet, but the best way we found was to use the Microsoft XPS Document Writer to create a file, email it to another computer and print it from there. Hardly an ideal solution.

Unless BT releases a BT Sport app for the RT, we can't see that working either, as Silverlight won't be coming to Windows RT. Unfortunately, neither will Windows 10, as it will only be an update from Windows 7 or 8, not RT. There's no way Google Play apps will come to Windows RT tablets either, as Android apps would need to be completely rewritten to work on Windows.

The Surface 2 is a lovely bit of hardware, but is unfortunately crippled by an operating system that Microsoft and others are in the process of abandoning.

IGNORANCE IS NO DEFENCE

 I was interested to read your article about online dispute resolution and virtual courtrooms (*News,*

Shopper 327). What I seem to have missed is the role auctioneers will be playing in this new development. Or was the illustration of an auctioneer's gavel just the usual confusion of British court procedure with American courts as portrayed in films and on television? Judges in England and Wales do not use a gavel, and there is no evidence that they have ever done so.

Star letter

POETRY CORNER

Words don't describe the joy
Your mag brings to me
New systems tested, laptops too
That cracking Samsung SSD
In issue 323
Imagine my delight
When glowing on the shelves
Magnificent component test
I could hardly control myself
I ditched my shopping trolley
And headed to the till
The cover alone did the trick
Anticipation of the thrill
But perhaps you could assist me now
I am disappointed you see
In your processor comparison
No Pentium Anniversary
Just some scores would help
This ageing techno fan
I think my poetic skills
Can't save me from this ham
Damn

Mark Dennison


Thank you sir for your poem
We appreciate the praise so glowing
If you have the cooling capacity
Crank up the Anniversary
We've seen 4GHz and more
And a high 55 overall score

At least the slip shows that none of the editorial team has been unfortunate enough to have had to appear in a courtroom in civil or criminal proceedings. This is the first time I've noticed an error in *Computer Shopper* in the years I've been a subscriber: keep up the (otherwise) great work.

Bill Stansfield

Thank you for pointing out the error, and we're glad it's the first one you've seen! The Editor has donned his black cap and sentenced the Mac-loving Art Editor to a week of using Windows 8 as penance.

THE PRO PERSPECTIVE

 First, a cracking issue with Facebook fixes and Raspberry Pi media player (*Shopper 326*). As an IT professional I found your reviews a really useful starter for replacing my current work laptop. You have highlighted some of the key factors for these types of laptops: look for an i7-4710MQ or higher processor, mid-range GTX 850M graphics, fan noise, keyboard and touchpad comfort. I thought of a few things you didn't mention, such as:

1 With Windows 10 RTM likely in the summer, there need to be some guarantees

➔ Microsoft's Windows RT operating system severely hampered the Surface tablet and is being abandoned



covering the availability of drivers. Are any of the manufacturers testing the laptops with the Windows 10 preview plus beta release drivers?

2 All the machines bar one were limited to 16GB memory, which would limit setting up virtual machines hosting server installations (such as SQLServer, Oracle, SharePoint and so on).

3 Is there a choice of 5,400 or 7,200rpm hard disks, and would the faster disk make any significant difference?

4 With the choice of matt or other screen types available, it would be good to do a 'glare test'.

Maybe these questions could be addressed in a review of Windows 10 Ready desktop replacements for IT professionals and developers.

Daniel Westerdale

We're glad you enjoyed the issue, and thank you for your suggestions. We can certainly test hard disk speeds – boot-up times and application loading are the most likely things to be affected. A standardised glare test to see how well a laptop copes under office lighting would also be useful.

Regarding Windows 10 drivers: there are already laptop drivers available for AMD and Nvidia graphics cards, for example, but these are currently very much in beta. Windows 10 is such a big deal for the PC industry that we're sure manufacturers will be testing their drivers in the run-up to launch, particularly as 10 will be a free upgrade from Windows 7 and 8, but we can certainly check for driver availability when testing.

SAFETY FIRST

The issue of mains-plug or adaptor pins pulling out (Letters, Shopper 327) is long standing and has been a problem ever since pins held in place by the moulding came into use (my first encounter was in the early 1980s). The use



↑ The EC publishes a weekly list of products it considers to be unsafe, which you can find at tinyurl.com/rapexalerts

of moulded IEC leads may not help because the problem is with the plugs that go into the wall sockets. The main issue is either the use of poor moulding or materials in the first place or overheating of the moulding due to poor internal circuit design and cooling.

If you have a problem, go to the Trading Standards reporting page on the Citizens' Advice website at tinyurl.com/tradingstandardsreport. The complaint then gets passed on to your local TS office, and they will investigate if they think the problem is serious enough. I did this a couple of years ago and a local TS official came to see me a few days later, and they then took it up with the supplier, although I never found out what the actual outcome was.

For more information on all the product alerts and recalls across Europe, take a look at the EU Commission 'RAPEX' website at tinyurl.com/rapexalerts. There are thousands of all types of unsafe products listed on this site, along with any actions that are being forced on the importers and distributors.

John Allen

The RAPEX site is both fascinating and terrifying. Thank you for the information. ☹

WRITE IN AND WIN

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with the BX100 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

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PLUS

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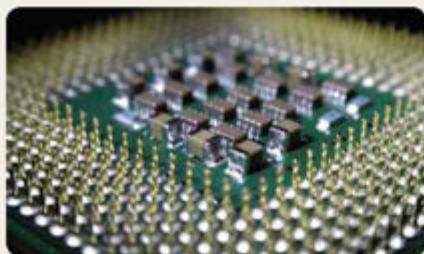
NEXT MONTH

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HOW PROCESSORS WORK

They're integral to computing, but how do processors actually work? We separate our NANDs from our NORs and XORs to explain



IP CAMERAS

Need to keep an eye on your house, car, kids or cat wherever you are? You need an IP camera. We test the best

ERADICATE BLOATWARE

New PCs are often chock-full of unwanted software. We show you how it's slowing down your PC, and how to get rid of it for good



CREATE VIDEO FAKES

Amaze your friends with impossible stunts captured on camera – with a bit of help from your computer

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PA system

Ever wondered how **David Robinson** stays so organised? It's all down to a venerable Windows 3.1 program that's still keeping things in order after 22 years



DAVID ROBINSON
Software and systems developer
letters@computershopper.co.uk

LAST MONTH I was in the process of abandoning a bit of kit that had served me well for close to 15 years: my Tech-Air laptop rucksack. This month's tale involves a piece of software I've had for even longer: 22 years, to be precise. What's more, it's a Windows 3.1 program that doesn't look dated and, even more amazingly, it does some jobs in a superior manner to any current alternative. Unlike my poor old bag, this one certainly hasn't outlived its usefulness.

ECCO & THE FUNNY MAN

I was introduced to Ecco Pro by former *Shopper* editor Jeremy Spencer in 1993, who said he'd just received the most wonderful program that you could use as a phone book, personal organiser, outliner, database, time logging system and, as the BS marketing men say, much more! And he'd arranged for the publishers, Arabesque Software, to send me a copy. Those were the days when you could spend £250 on a legal copy of a word processor, and writers could often blag a free copy. Now most software is either free and deficient in some way or it's expensive and getting a freebie is nigh on impossible.

Most software is free and deficient or it's expensive and getting a freebie is impossible

Since then I've used Ecco both for project planning and systems analysis, starting with high-level features then adding more and more sub-levels of detail. The outliner is superb. You can do outlining in Word, but it's a pale imitation of what Ecco can do. In 1993 Word was able to indent information, but it couldn't expand and collapse levels. Microsoft has cured that; but Ecco goes way further.

The main difference is that outlining in Word is primarily

used to organise the structure of the document you're working on. Ecco uses a database record as its fundamental building block and has a simple but clever way of linking these records together. This allows you to organise complex data so you can view information sets on many levels.

By chance I found an internet reference to a 64-bit version of Ecco that works on Windows 7 and 8.1 (eccopro.com). You can download it for a wallet-friendly \$20, and you get a year's support and access to online support.

You can use Ecco straight out of the box and change or add to the configuration to suit your needs without messing up your existing information. It comes set up with a calendar, phone book, to-do list and notes views. If you want to get a really powerful implementation with minimal work, you can simply download the enhanced business or legal templates and tweak to taste.

COLUMN INCHES

These templates use a nifty Ecco feature that allows you to add columns to your outlines, which you can't do in Word. Ecco lets you add an extra notes page called Estimates, for example. You'd then add a column to the standard to-do list that links to the Estimates page. So, if you add an item to your to-do list and put a tick against it in the new Estimates column, the To-Do item automatically appears in the Estimates notes page. This makes it easy to see all your estimates in one place rather than picking them out of a list of to-dos.

You can edit the item in either location, including adding multiple levels of outlined sub-items and links to document spreadsheets and pictures, and the changes appear in both locations. When you mark the item as 'done' it's automatically removed from the to-do list and appears in the archive Done folder. It's brilliant and full of

usable and well thought-out features. For a video demonstrating Ecco Pro (taken on VHS by the look of it), see tinyurl.com/eccopro.

LOYAL SUPPORT

But wait, there's more! I've also been using a program called MyPhoneExplorer (MPE) that lets you manage your Android phone from a PC, and synchronises MS Outlook contact details, tasks and so on with Google accounts and your mobile. It has also recently added Ecco support.

Having the ability to link my personal organiser details to my Nexus 7 tablet and Gmail calendar looked an attractive proposition, so I signed up for MPE at a cost of \$20. However, the impression given by the website is misleading. This states that MPE will synchronise Thunderbird (which I use as my primary email client on my laptop), Outlook (don't use it at all), Google, your Android phone and, now, Ecco. What it doesn't say is that it won't sync them all at once. This is unsurprising but, nevertheless, a bit disappointing.

The upshot is that Ecco-to-Android sync works well on the Lenovo laptop, but there seems to be no way of incorporating Google account data at the same time. Frankly, I'm not that bothered. There seem to be lots of places I go where I can't get a decent internet connection, so managing all my appointments and tasks using Google's facilities isn't a viable proposition anyway.

I was talking with one of Effing Jeff's managers and proselytising about the merits of Ecco as a personal organiser and manager that does it all. He relayed the conversation to Jeff and, between them, the discussion must have been misunderstood: later on Jeff phoned me and said, "I hear you've got a new personal organiser called Echo. Is she blonde or brunette?" ☒

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Open house

Now that Smart TVs can listen in to every word we say in our own homes, should we be worried about the privacy implications? **Gordon Holmes** thinks we should



GORDON HOLMES

With more than 30 years of experience in law enforcement, our retired cop gives a police officer's perspective on the sticky subject of cybercrime
letters@computershopper.co.uk

RECENTLY I'VE BEEN working with some ex-colleagues, and I've been surprised at how easily we've all slipped back into the banter that comes from our shared experiences over 35 years of law enforcement. The office resembles the BBC's *New Tricks*.

I'm not a huge fan of the show, but I've caught a few episodes and the similarities between its characters and my workmates is quite marked. One colleague, who looks and sounds a bit like the Dennis Waterman character, raised his head the other day and uttered the words, "Ere, what about them smart tellies that listen to you, Samsungs they are. Can listen to every word that me and 'er indoors are saying of an evening."

The techie Brian Lane character raised an eyebrow and said, "Really? That's scary. The bad guys will know what you're having for tea all week now. I'd practise your anti-surveillance techniques on the way home if I were you in case they slip you a duff tin of baked beans."

SMART TALK

Just in case you missed it, this conversation was about a news

device was the target of our voice commands. I think the Samsung-specific privacy concerns could be a little overplayed, as there are a multitude of devices that employ this feature, such as Microsoft Kinect and Google's and Apple's phones and tablets. However, a TV with this feature is equipped to breach an individual's right to privacy in their own home, and this ups the ante somewhat.

FREEDOM OF SPEECH

How many people bother disabling this feature in their devices? Not many, I suspect. Most will willingly give their privacy rights away to some big corporation just for the convenience of not having to press a button, so perhaps this situation deserves a little further thought.

My guess is that this technology will become more sophisticated, and the analysis of conversations overheard in the home will lead to targeted advertising of goods and services, in the same way as cookies are used as you browse the web, whether you like it or not. This kind of information is invaluable to advertisers and, as we all know, online advertising is very big business indeed.

Now it's common knowledge that all these voice-recognition services rely on transmitting data to the cloud, how long before a curious hacker hunts down the servers, hacks in and offers an eavesdropping service to all and sundry? Not long, I'll bet. Personally I think I may have said my last "OK Google".

Surveillance by the state is rightly heavily regulated here in the UK, so how does this fit in with us giving access to the privacy of the inside of our homes to corporations that are outside of our country's jurisdiction and have no obligation to abide by our laws?

I suppose that if we are happy to live with this technology, then

we should expect that it could also be used for the purposes of our own security.

It actually amazes me that whenever we hear about a terrorist that has travelled to join comrades in support of whatever cause he or she feels is right, the general hue and cry is directed towards the UK security services, with complaints along the lines that they should have been alert to the potential terrorist's movements and they should have been stopped. It appears to me that the appetite for quite intrusive surveillance in these cases is pretty high.

We must acknowledge the fact that to physically monitor everyone who is identified as a potential wrongdoer is impossible, so is it feasible that voice recognition could be used to pick up keywords in whatever language and use them to alert the security services? Are you comfortable with that?

INTRUSIVE QUESTION

I could be taking this too far. As the Internet of Things starts to develop around us, perhaps a certain level of intrusion is simply the price we have to pay for the convenience of living in a connected world.

The story of the Samsung smart TVs was treated in quite a light-hearted and flippant manner by most commentators, and I agree that perhaps we should keep a sense of proportion about all this, at least for the moment.

It's just that I feel uneasy about allowing faceless corporations which exist to make profit for their shareholders to decide on matters of privacy. I worry about how such firms will push this technology, how it will evolve and what they will do with the data gathered from the supposed sanctity of people's homes. In short, I just don't trust them – but maybe that's just the way I am. ☹

Most people will willingly give their privacy rights away to a big corporation just for the convenience of not having to press a button

item in which Samsung admitted the voice recognition feature in its Smart TVs actively listened out for voice commands and, if your words contained sensitive information, this could be among data sent to a third-party server that analyses the speech and subsequently issues the appropriate command to the TV.

I admit I had no idea that voice recognition relied on this sort of process, and had thought the software resided in whichever

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RANTS & RAVES

We can't use the new MacBook, and we refuse to talk to the new Barbie doll, but at least we haven't lost our competitive spirit



Mel Croucher

RANTS

Just when you thought Barbie dolls couldn't get any more sinister, they start extracting marketing data from your little darlings

WHEN I WAS a little boy, and the world was still monochrome, I read a book that gave me the willies. It was called *Brave New World*. Written by Aldous Huxley in 1931, it was set 500 years in the future. Huxley prophesied the brainwashing of infants via softly spoken speakers in their pillows, and I've been suspicious of pillow-talk ever since.

I was similarly spooked in 1969, when Brian Aldiss wrote his short story *Supertoys Last All Summer Long*, set in the late 21st century and the basis for Steven Spielberg's *A.I. Artificial Intelligence*. The mother of an android child finds it easier to communicate with the child's robot teddy bear than with her surrogate infant. Personally, I thought the teddy was more sympathetic than the preprogrammed child or its cold-hearted parents, but I was still disturbed by teddy's computerised private whispers.

I don't play much with dolls myself; in fact, I've always found something sinister about them. And the most sinister of all dolls is that blue-eyed blonde Barbie. Not because of her impossibly thin waist, or

even the absence of genitalia. She's sinister because she learned to talk in 1992, and began to force-feed propaganda to little girls, including "math class is tough" and "I love shopping". What a stupid bitch.

Soon Barbie will become even more sinister than the whispering pillows of Aldous Huxley or the talking teddy bear of Brian Aldiss. Barbie has been impregnated with a battery power supply, a miniature computer, a speaker and a microphone, and the wee poppet is linked to a vast databank via Wi-Fi. I suspect it is only a matter of time until Barbie's eyes become cameras.

As it is, her voice-recognition software can analyse whatever junior utters in Barbie's presence, and the data is stored for harvesting on a remote server. Barbie can hold a real-time conversation with a child, adding to her onboard supply of pre-recorded banalities, with the declared intention for the doll to become the child's bosom buddy, confidante and constant spy.

To be honest, if Barbie's voice recognition can decode the unstructured

speech patterns and burlblings of infants, it's an impressive achievement. But to be dishonest, parents are thrown the sop of inputting information such as a birth date, a pet's name or a wishlist, and in return they can receive a daily email from Barbie revealing what secrets their abandoned offspring has spilled. Of course, if momma and papa know such secrets, then so does any marketing and propaganda agency given access to the same data. And please don't insult my intelligence by telling me the data is either safe or secure. It is simply the next step on the commoditisation of individuals from the cradle to the grave.

The pre-publicity reckons that this Talk Barbie will cost around 50 quid when she is introduced into the UK, just in time for Christmas, and I have no doubt at all that she will be followed by sentient data-collection toys of all kinds, including wise old teddy and the talking pillow. The future is not Aldous Huxley or Brian Aldiss. The future is now. The future is Barbie pink. And pink stinks.



Chris Finnamore

RANTS

How many ports does a laptop need? Apple seems to think you'll only want one, but that's not enough for even the most basic tasks

AT THE BEGINNING of March, Apple launched a new MacBook. This replaces the MacBook Air, and it looks beautiful. It's thinner than the old model, it's fanless, it has a new keyboard with fancy 'butterfly switches' to aid typing accuracy, and the touchpad can recognise the difference between soft and hard taps so the laptop can react accordingly.

It looks like the perfect laptop (well, apart from the eye-watering £1,049 cost of the base model, that is), but there's one major flaw. The MacBook has only two ports.

One of these is a headphone jack. The other is a new USB Type-C port, which is also used to charge the laptop. USB Type-C is the biggest revision to the USB port design since it was launched in 1996. It's smaller than the original, is reversible, supports far faster data throughput and can deliver enough power to charge your laptop as well as transfer data.

USB Type-C is excellent but, for us, the fact there's only one way to plug things into the MacBook seriously compromises how useful it is as a computer. We can imagine being fine using it at home, surfing the web on the lovely 2,304x1,440 display while typing on the typically excellent MacBook keyboard, but it would be useless to take to a product launch.

Such launches normally involve taking lots of photos of a product, then hurriedly transferring these on to a computer, editing them, writing copy and uploading the whole lot to our sister website Expert Reviews. Time is of the essence to get your story up before the competition.

As Apple has removed the card reader from the MacBook, the only way to get your photos on to it is to use a USB card reader. To connect one of these to your MacBook, you'll need a £15 USB-C to USB adaptor, but to plug this in you'll need to unplug your MacBook from the mains.

There is a way to make sure you don't have to worry about running out of juice before your pictures have uploaded, but this involves spending £65 on a USB-C Digital Multiport adaptor, which will give you a single USB3 port and an HDMI output along with a USB-C charging port.

Want to plug in the USB stick with the press pack? No free ports. Need to use a USB 4G data dongle to get online? You can't. Well, you could use a USB hub, but plugging a USB hub into a USB-C adaptor into your MacBook is just a mess of cables and a sure-fire way to make your achingly cool MacBook look highly gawky.

This is a shame, as when you're lugging your laptop from Hall 3 to Hall 75 on an expo site in Berlin you appreciate having a light computer in your backpack, and don't want to have to pack several expensive accessories so you can do your job. The new MacBook is not for us, therefore – but there's always the MacBook Pro.



Richard Easton

RAVES

Don't just go for the biggest name when you buy a product – check out the competition and you may bag yourself a better bargain


COMPETITION IS A wonderful thing. A competitive market typically means more choice and better products for us consumers. Sometimes, however, certain products will lead the pack by a country mile and be so far ahead of everyone else it doesn't seem like a fair fight.

If a product becomes ubiquitous enough, its influence may extend beyond simple market share and sales and into the realm of your mind. If you're considering a multiroom audio system, you'll most likely think of Sonos. Streaming music will probably lead your mind towards Spotify. Action cameras? GoPro will surely pop into

your brain. This might make it easy to overlook the rest of the market and always gravitate towards the big names, but doing so means you'll miss out on some great products and fantastic bargains elsewhere.

This is because, oddly, the big brands' market dominance doesn't cause all smaller rivals to be squeezed out of the market. Instead, many firms try that much harder to compete. Beyond trying to make a better product, this often translates to a whole bunch of added value. In the case of an action camera from a GoPro rival, this could mean a box full of accessories that you'd normally have to buy separately. Another

example is Google including YouTube Music Key, which gives you ad-free music videos, with its Google Play Music service to try to gain an edge over Spotify.

Such special offers sit alongside highly competitive pricing from rivals as they seek to offer the best value to the consumer, which is a headache for finance directors up and down the land but great news for you and me. It's easy to be drawn to the most popular product or service when buying new tech, but some research and due diligence goes a long way to making sure you're getting the biggest bargains. And who doesn't love a bargain? 



MOBILE

WORLD CONGRESS

THE HIGHLIGHTS

MOBILE WORLD CONGRESS, the world's biggest trade show dedicated to smartphones, tablets and all things mobile, took place in March and saw major announcements from all the big manufacturers. We were on the ground in Barcelona to see it all.

SAMSUNG HAS THE EDGE

Samsung was firing on all cylinders this year, as it announced two flagship smartphones. The Galaxy S6 and Galaxy S6 Edge are both huge improvements on the outgoing Galaxy S5: each one has a 5.1in 2,560x1,440-resolution display, Samsung's latest quad-core 2.1GHz Exynos 7420 chip, a 16-megapixel rear camera, wireless charging and a stylish metal chassis.

Moving to a metal case is the best thing Samsung could have done for its new handsets, and it's done a particularly fantastic job with the Galaxy S6. However, it's the S6 Edge that really caught our eye, as its pair of curved edges makes it one of the best-looking smartphones we've ever seen. It follows on from the Galaxy Note Edge, which had a curved screen on one side of the display, but this time round Samsung has increased its efforts to make its titular sloping edges a more integral part of the handset.

↓ With its two curved sides, the Samsung Galaxy S6 Edge is certainly an eye-catching phone



People Edge, for instance, gives you quick access to five key contacts when you swipe in from the right edge, and each contact can be assigned a different colour, which will light up the side of the phone when it's face down on the desk so you know who's calling. The Night Clock also makes a return appearance, which shows the time, date and weather on the edge of the phone during set hours of the day.

Like the Galaxy S5, the S6's home button doubles up as a fingerprint reader. This can be used to unlock the handset, but it will also let you authenticate financial transactions with Samsung's upcoming mobile payments system, Samsung Pay.

Available in 32GB, 64GB or 128GB models, both phones should be on sale in the UK by the time you read this. We'll bring you our full reviews in the next issue.

HTC STEAMS INTO VR

One of the biggest surprises at MWC was HTC's announcement that it would be joining forces with game developer Valve to create a new virtual-reality headset. Named the HTC Vive, the lightweight headset will be powered by Valve's SteamVR technology and will have a 1,200x1,080 screen in front of each eye. HTC also promised a refresh rate of 90Hz to deliver super-smooth visuals and help prevent motion sickness.

To track the rotation of your head, the Vive has a built-in gyroscope, accelerometer and laser position sensor. HTC says this should be able to track your movements on both axes to 1/10th of a degree, so it should be extremely accurate. Vive will also be able to track your physical location in spaces up to 3m², but you'll need to install a pair of Steam VR base stations first.

As for your game controller, Vive will use special VR controllers which sit in each hand. The position of these controllers is then tracked in space, allowing you to reach, open doors and shoot in supported games.



↑ There were plenty of rumours about a Valve VR headset, but few expected it to be made by HTC

At the moment, the Vive is only available as a Developer Edition headset, but a full consumer model is currently slated for the end of 2015.

HUAWEI CLOCKS IN

Instead of announcing a new range of smartphones at MWC, Huawei launched a host of new wearables this year, including its very first smartwatch. The Huawei Watch has a circular screen and a cold-forged stainless steel bezel to help give it that premium look and design. It's also the first Android Wear smartwatch to use sapphire crystal glass for its main watch face.

Made from over 130 individual components, the Huawei Watch's 1.4in AMOLED display has a 400x400 resolution. This is the highest resolution we've seen on a smartwatch, so Huawei's range of over 40



↑ The stainless steel Huawei Watch will be available in gold, silver and black, and with both leather and stainless steel watch straps

customisable watch faces should look incredibly sharp once it launches this summer.

It's also highly customisable, as you'll be able to buy it in gold, silver and black with a variety of different strap options, including leather and stainless steel. It's a chunky piece of kit, especially if you have small wrists, but it's packed with sensors, including a fitness tracker, heart-rate monitor, a six-axis motion sensor and barometer to detect whether you're running, walking, cycling or climbing.

MICROSOFT GETS LUMIA RIGHT

We weren't very impressed with Microsoft's first Lumia phone, the Lumia 535, but the newly announced Lumia 640 and Lumia 640 XL look more promising.

Both handsets sit toward the lower end of Microsoft's 2015 Lumia line-up, but each one is incredibly well made. The new cyan shade is particularly attractive, but they will also be available in white, black and bright orange, with either gloss or matt finishes depending on which colour you choose.

The 5in Lumia 640 is the smaller of the two handsets, but it has the same 1,280x720 resolution as the 5.5in Lumia 640 XL. This means the XL doesn't look as sharp as its little brother, but both devices have incredibly punchy colours and deep-looking blacks. Each phone will be powered by a quad-core 1.2GHz Snapdragon processor and 1GB of RAM, but the XL gets the superior camera: 13 megapixels as opposed to the Lumia 640's 8-megapixel sensor. Unsurprisingly, the Lumia 640 XL also has a bigger battery, so it should be able to last longer throughout the day.

Microsoft revealed that each phone comes with a year's subscription to Office 365 with 1TB of OneDrive cloud storage, adding even more value to the handset. The offer will be valid across all Windows tablets and PCs too, allowing you to seamlessly sync your Office docs on the move across all your devices.

UK pricing and availability has yet to be announced for both handsets, but the Lumia 640 should cost around €139 (around £100) for the 3G version or €159 (around £115) for the 4G version. The Lumia 640 XL, meanwhile, should cost around €189 (£137) for the 3G version or €219 (£160) for 4G.



◀ We didn't think it possible to make a more desirable tablet than the Xperia Z2 tablet, but Sony proved us wrong with the featherweight Xperia Z4

SONY TAKES A BITE OUT OF APPLE

While most manufacturers were busy promoting their new flagship smartphones, Sony chose to focus on its latest Xperia Z4 tablet this year, and with good reason. Weighing just 392g, it's the world's lightest 10in tablet, beating the iPad Air 2 by 45g. The Xperia Z4 is just as slim, too, measuring an astounding 6.1mm thick.

Its gorgeous 2,560x1,600-resolution display is another key feature, giving it a pixel density of 299 pixels per inch. This once again beats the iPad Air 2 by quite a large margin, so everything from films to photos should look razor sharp on the 16:10 display. With a claimed brightness of 500cd/m² you should also be able to use the Z4 outside without any problems and, like previous Sony Xperia tablets, it's rated as IP65/68 waterproof, just in case you get caught in a sudden downpour.

Even its capless USB port is waterproof this time round, so you won't need to worry about sealing it off with a fiddly plastic cap ever again. This is a welcome addition in our eyes, as we always thought the flap on previous models detracted from the tablet's overall design and premium feel.

The Z4 is powerful, too, as Sony claims its octa-core 2GHz Qualcomm Snapdragon 810 processor and 3GB of RAM should make it twice as fast as the current Xperia Z2 tablet. It will also have 32GB of onboard storage and a microSD card slot to expand this even further.

Sony is not merely positioning the Xperia Z4 as the ultimate entertainment device, either: it's also releasing an additional Bluetooth keyboard dock for the Z4 to give users a workable laptop experience. The Android operating system may not be quite as flexible as Windows, but Sony's clever desktop features – such as adding a row of icons along the lower edge of the screen and a Start screen-like app launcher – certainly make it more intuitive when using a touchpad.

The Lumia 640 XL (left) shares some specs with the smaller Lumia 640 (below), but it has a better camera and bigger battery



Sony hasn't announced a firm UK price or release date for the Xperia Z4 tablet yet, but it should be available some time this spring.

STOP! IT'S PEBBLE TIME

Huawei wasn't the only company with a brand-new smartwatch this year, as Pebble's new Time and Time Steel smartwatches were also on the show floor. After a phenomenally successful Kickstarter campaign (which had raised over \$19.5 million at the time of writing), the Pebble Time smartwatch is coming to market in May.

The Time improves on the original Pebble by adding a colour e-paper screen and voice control. It's also more compact than other smartwatches we've seen, as it's both smaller in footprint and shallower, making it less obtrusive on your wrist.

The plastic Time is very light, and the Time Steel is significantly heavier, but the Steel has a bigger battery, giving you up to 10 days' battery life compared to the Time's seven.

As with the original Pebble, the Time doesn't use a touchscreen. Instead, you control it by tapping its various side buttons. The interface is a little different this time round, as notifications, news, reminders and events are now split into past, present and future, each of which is controlled by one of the three side buttons on the right of the watch.

This means you can view all upcoming appointments or go back in time to see an unread email without having to hunt through individual apps. This is where the colour e-paper screen really comes into its own, as you can assign different colours to each time category so you know where you are.

The Pebble Time is available to pre-order through its Kickstarter page, and will set you back \$179 (around £120) for an estimated delivery in June this year. Early-bird prices were as low as \$159 (£107) for delivery in May, but these were snapped up almost immediately when Pebble first launched its Kickstarter campaign in March.



Windows 10 to launch this summer

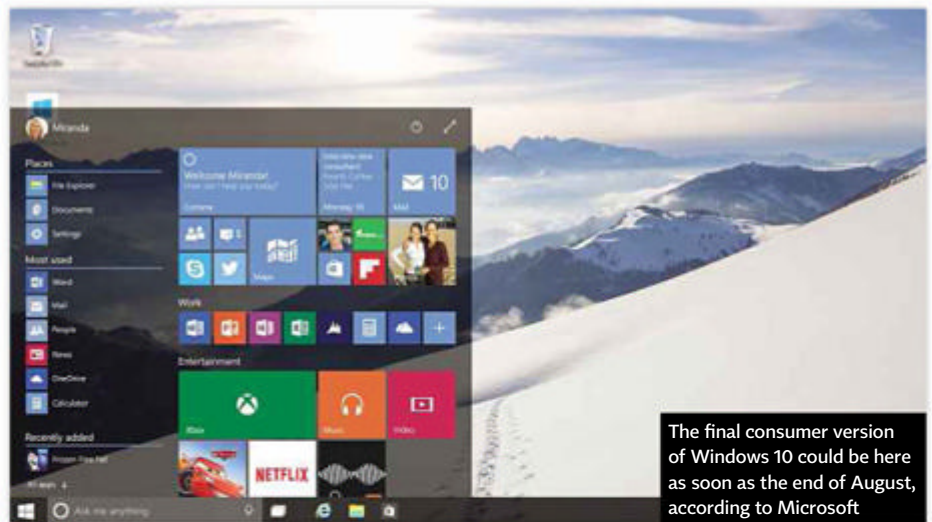
WINDOWS 10 WILL be launched in the summer, giving Microsoft as little as three months to put the finishing touches to the operating system. If it stays on schedule, Windows 10 will be ready for the crucial back-to-school PC market – but it won't ship with a version of Internet Explorer, for the first time since Windows XP.

Microsoft still has work to do before the OS can be considered complete. The latest build, released in March, finally added a UK version of the Cortana voice assistant, but it still doesn't include the Spartan web browser or the ability to stream games from Xbox One consoles – both of which were unveiled at Microsoft's Windows 10 event in January.

However, Windows chief Terry Myerson says the OS will be released next quarter. "We continue to make great development progress and shared today that Windows 10 will be available this summer in 190 countries and 111 languages," he wrote on a Microsoft blog.

It's not precisely clear what Myerson means by "available". Windows is normally considered complete when it hits the Release to Manufacturing (RTM) milestone and is given to PC manufacturers for testing. That's normally around six to eight weeks before the OS is made available to the public.

Given that Microsoft is making Windows 10 a free upgrade for those already running Windows 7 or 8, it could be made available for



download at the RTM stage, although that would upset Microsoft's PC manufacturing partners, who would prefer to have Windows 10 pre-installed on new PCs before the public was given the chance to upgrade their own systems. If, as seems likely, Microsoft waits for PC firms to have stock on the shelves before releasing Windows 10 for download, it's highly likely we won't see the operating system until the back end of the summer.

One feature that Microsoft's testing team won't need to bother with is Internet Explorer.

Microsoft is shelving the brand that has been used for all of its web browsers since 1995.

Windows 10 will ship with the new Spartan browser, a lightweight app designed to run on everything from phones to workstation PCs. Microsoft hasn't finalised Spartan's branding, but confirmed it won't be using the Internet Explorer moniker. IE will still be available as a separate download, however, predominantly to support businesses who have built web applications that are compatible with older versions of Microsoft's browser.

Apple reveals new ultra-thin fanless MacBook with a single port

APPLE HAS ANNOUNCED a new MacBook for 2015, replacing the MacBook Air as the company's thinnest laptop to date. At just 13.1mm at its thickest point and weighing 920g, the new 12in model is almost 25% slimmer than the 11in MacBook Air.

To achieve such compact dimensions, Apple has ditched almost all the ports from around the sides, leaving a single USB3 Type-C connector to act as power, video and network all in one. This means there's no SD card reader or standard USB ports for flash drives; Apple expects customers to use Bluetooth and 802.11ac Wi-Fi instead. Thankfully there's still a 3.5mm audio jack on the other side for plugging in a pair of headphones, meaning anyone without a Bluetooth headset will still be able to listen to music. The port also doubles as a microphone input, which will be useful for FaceTime calls.

Apple has also redesigned the keyboard and touchpad, concentrating on thickness. The old dome switches under the keys have been replaced with more accurate butterfly switches, which require less movement to register a key press. The keys now reach to the edge of the chassis, and each one is individually backlit.

The touchpad can now detect pressure, with a new Force Click feature recognising the difference

between a soft tap and a more forceful press to perform actions such as opening Maps when clicking on an address, or setting a Calendar appointment when tapping.

The new MacBook is the first Apple laptop with completely fanless construction, meaning silent operation. Apple has used an Intel Core M processor which typically runs at 1.3GHz and can Turbo Boost to 2.9GHz, but only consumes 5W of power. This is combined with 8GB of RAM and 256GB of flash storage. The entire logic board, which comprises the processor, memory, storage and motherboard, is 67% smaller than the board found in the 11in MacBook Air, leaving ample room for a battery.

Sheet batteries, which fill up far more space than traditional rectangular cells, mean the new MacBook has 35% greater capacity than the outgoing MacBook Air. That should translate to around nine hours of web browsing or 10 hours of video playback.

Finally, the new MacBook gains a Retina display screen. The 12in IPS display has a 2,304x1,440 panel that slots in between the MacBook Pro 13in's 2,560x1,600 panel and the iPad Air's 2,048x1,536 resolution. The FaceTime camera built into the screen surround has a disappointing 480p resolution; we would have liked to see 720p at least, especially considering the price.

The new MacBook is now available in space grey, silver and gold, with prices starting from £1,049 for the entry-level model with 8GB of RAM and 256GB of storage and £1,299 for the top-end model, which has a faster processor and more storage.

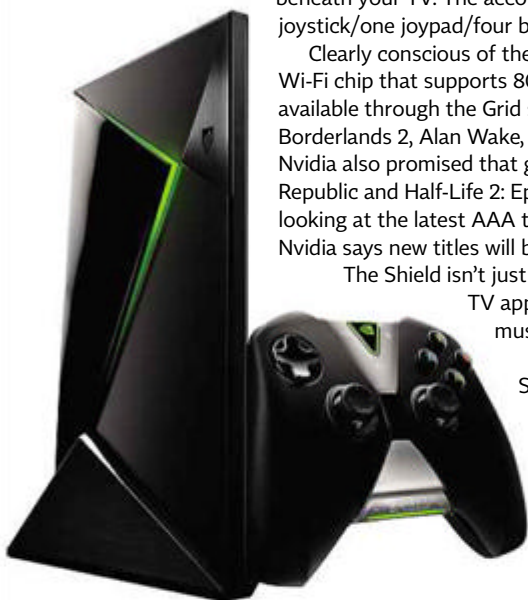
◆ The new MacBook will be Apple's thinnest laptop yet, measuring just 13.1mm at its thickest point

Nvidia Shield games console to offer 4K gaming for just £134

THE CONSOLE WARS have a new entrant with the Nvidia Shield, a 4K-capable games console that runs on the Android TV platform. Nvidia had previously released an Android tablet under the Shield brand, designed to stream games over the company's Grid service. The new Shield console is designed for the exact same purpose, providing under-the-TV competition for the Xbox One and PlayStation 4.

The console is powered by the Nvidia Tegra X1 processor unveiled earlier this year. The 256-core chip is the first mobile processor to offer a teraflop of throughput, according to Nvidia, and will be completed by 3GB of RAM. That will allow the console to output at resolutions of up to 4K at 60fps.

The console has a striking, angular design that's unlike any other set-top box that may be lurking beneath your TV. The accompanying controller adopts the now conventional two joystick/one joypad/four button design. Extra controllers cost \$60 (around £40).



Clearly conscious of the need for reliable streaming, the Shield has a high-end Wi-Fi chip that supports 802.11ac 2x2 MIMO at 2.4GHz and 5GHz. Games currently available through the Grid streaming service include the Batman: Arkham series, Borderlands 2, Alan Wake, various titles from the Lego series, and Saints Row 4. Nvidia also promised that games including Portal, Star Wars: Knights of the Old Republic and Half-Life 2: Episode 1 will be added to the store. In short, you're not looking at the latest AAA titles available on the Microsoft and Sony consoles, but Nvidia says new titles will be added to the Grid library on the day of their release.

The Shield isn't just for gaming: it also includes support for various Android TV apps, including YouTube, Plex and Google's movie and music stores. An optional remote control is also available.

Perhaps the most compelling thing about the Nvidia Shield is its price of \$199 (£134), significantly undercutting rival consoles. Games can be rented individually or you can pay for a subscription that gives you access to all 50 or so titles in the Grid library. Subscription prices will be revealed when the console launches in May.

◆ Nvidia's Shield console will stream games in 4K at 60fps using the company's Grid service

Intel Atom x3 CPU gets built-in modem and ARM graphics

INTEL HAS ANNOUNCED its first mobile system-on-chip (SoC) with an integrated modem: the Intel Atom X3, codenamed SoFIA.

Previous mobile Intel chips, such as the Bay Trail range, have separate wireless modems for use in 3G and 4G tablets, as well as smartphones. Having two chips is less power-efficient and more expensive, and makes it harder for Intel to compete with companies such as Qualcomm, with its Snapdragon integrated-modem SoCs.

There will be three Atom x3 models: the x3-C3130, the x3-C3230RK and the x3-3440. All three are 64-bit compatible, but their specifications differ significantly. The x3-C3130 is a dual-core chip running at up to 1GHz with a built-in 3G modem. The x3-C3230RK also has 3G, but is a quad-core processor and runs at up to 1.2GHz. Finally, the top-of-the-range quad-core x3-3440 run at up to 1.4GHz and has built-in 4G LTE.

Unusually, as Intel is known for manufacturing its own processors rather than outsourcing the process, the mid-range x3-C3230RK will be physically manufactured by China's Rockchip company. This will presumably keep costs down and, coupled with the integrated modem, make

Intel mobile processors particularly attractive for smartphone and tablet manufacturers.

The new processors use Mali graphics instead of Intel HD Graphics. Mali chips are designed by Intel's rival ARM, which is behind most mobile processors. The x3-C3130 has Mali 400 MP2 graphics, the x3-C3230RK has a Mali 450 MP4 chipset and the x3-3440 has Mali T720 graphics.

The Mali 400 is similar to the ageing chipset used in the Samsung Galaxy S3, and the T720 is described by ARM as a mid-range GPU which is similar to the Mali T628. The T628 chip scores around 13,000 in 3DMark, which means in terms of 3D graphics power even the top-of-the-range Intel x3 will still be a long way off the market

leaders such as the LG G Flex 2, with its 22,000+ score. The fact that Intel is now using ARM-based graphics should hopefully lead to fewer incompatibility problems in 3D games; we had significant problems with Bay Trail chips in games such as Assassin's Creed Pirates.

The high-end 4G x3-C3440 will be the first chip to market, and we're looking forward to seeing how it compares with rivals in normal use, in games and, most importantly, in battery life.



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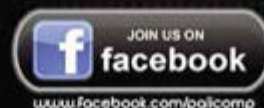


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(Code - PHO11)

Phoenix i5 Vortex

INTEL Haswell i5 4670K @ 3.4Ghz (Quad)
Overclocked to 4.4Ghz Per Core
ASUS Z87-K
PATRIOT VIPER RED V3 8GB 1600Mhz
2TB SATA3, 3Gb/s
SONY 24X DVD+-RW
nVIDIA GTX660 2GB



Superfish-infected Lenovo laptops still on sale

LENOVO MADE A huge security blunder last month by preinstalling dodgy ad software on its laptops that potentially leaves customers open to attacks from hackers. Called Superfish, the nasty software injects adverts into websites, making SSL connections insecure.

It was first noticed mid-2014, but Lenovo said it had stopped shipping the software at the start of 2015 and had only ever installed it on consumer laptops. Even so, many laptops are still affected, as we found out thanks to a reader tip-off.

A reader who bought a Lenovo Z50-70 laptop from John Lewis on the 14th February found that Superfish had been preinstalled on it when Kaspersky Internet Security detected it as 'Trojan.Multi.CertStor.a'. While Kaspersky removed the software from the PC, it's shocking that laptops could still be bought with Superfish installed.

To find out which laptops running Superfish were still available, we went to PC World on Tottenham Court Road and John Lewis on Oxford Street in London. We went through all the Lenovo laptops on show and looked for Superfish in the list of installed programs in Programs and Features, as well as for the Superfish trusted root certificate, which makes SSL insecure.

In PC World we found that the 14in Lenovo Flex 2 laptop (£500) was still infected, with the software installed and the root certificate in place. As the laptop was connected to the internet, we tested it using the Superfish vulnerability testing tool and received a warning message. PC World staff told us that a removal tool is available from Lenovo, and that the PC World Know How desk would check any Lenovo laptop purchase and remove Superfish before it left the store.

In John Lewis, we found that a Lenovo Z50-70 laptop (the same model as our reader bought) was also infected. John Lewis staff told us that head office hadn't said anything about Superfish, but the knowledgeable sales assistant we spoke to said a removal tool is available, that updating security software would remove Superfish, and that a better option would be to buy a laptop from a different manufacturer.

We asked Lenovo what its position is and how it's dealing with retailers and customers. Rather than provide a dedicated reply, Lenovo

IS YOUR LENOVO LAPTOP AFFECTED BY SUPERFISH?

For those still interested in Lenovo laptops, here's a list of models, which Lenovo says "Superfish may have appeared on":

G Series: G410, G510, G710, G40-70, G50-70, G40-30, G50-30, G40-45, G50-45

U Series: U330P, U430P, U330Touch, U430Touch, U530Touch

Y Series: Y430P, Y40-70, Y50-70

Z Series: Z40-75, Z50-75, Z40-70, Z50-70

S Series: S310, S410, S40-70, S415, S415Touch, S20-30, S20-30Touch

Flex Series: Flex2 14D, Flex2 15D, Flex2 14, Flex2 15, Flex2 14(BTM), Flex2 15(BTM), Flex 10

MiIX Series: MiIX2-8, MiIX2-10, MiIX2-11

Yoga Series: Yoga 2 Pro-13, Yoga 2-13, Yoga 2-11BTM, Yoga2-11HSW

E Series: E10-30

simply responded with its open letter, written by Peter Hortensius, CEO. As well as talking about Lenovo's removal tool, it says, "Microsoft, McAfee and Symantec updated their software to automatically disable and remove this Superfish software. This means users with any of these products active will be automatically protected. We thank them for their quick response.

"Together, these actions mean all new products already in inventory will be protected. Shortly after the system is first powered on the AV program will initiate a scan and then remove Superfish from the system. For systems which are re-imaged from the backup partition on the HDD Superfish will be removed in the same manner. For products already in use, Superfish will be removed when their antivirus programs update."

In other words, Lenovo is relying on third-party tools and customers' actions to remove this software, and computers are still being sold with it pre-loaded. Anyone who restores their computer using the factory restore option will also restore Superfish. Lenovo says the same tactic as above (waiting for the security software to update) will remove the program. Lenovo is also working on creating clean factory restore partitions.

For now, if you plan to buy a Lenovo laptop you have three choices. First, you can go to a store and check if the demo unit is clean. Second, you can buy a laptop and leave it to the security software to detect and remove Superfish if it's preinstalled. Third, you can buy any other make of laptop instead.

✦ The Yoga 2 Pro is just one of the Lenovo laptops that could still be running Superfish software



BT last in broadband satisfaction survey

BRITAIN'S BIGGEST BROADBAND provider, BT, has come last in a customer satisfaction survey of 11 ISPs conducted by consumer watchdog *Which?*. BT achieved an overall score of just 45%, as once again the biggest broadband providers were found wanting when it comes to customer service.

Which? surveyed broadband customers across a range of criteria, including speed of connection, technical support, customer service and reliability. BT failed to excel in any of those areas, and scored particularly poorly for value and technical support.

Things were little better at Sky and TalkTalk, which finished joint ninth in the table with an overall satisfaction score of 48%. Speed and technical

✦ BT scored well for ease of setup in the *Which?* survey, but performed poorly in value for money and technical support



support were the weakest parts of TalkTalk's service, according to the survey results, while Sky was little more than mediocre across the board. EE Broadband, which is soon to be bought by BT, fared almost as poorly, achieving an overall score of 50%, with technical support once again identified as a weak spot.

One good piece of news for BT was results for Plusnet. The BT-owned provider finished fourth overall, with a much healthier score of 72% and top marks for customer service. It's perhaps worth noting that Plusnet operates its own UK-based customer support centre, while most of BT's customer care is outsourced to call centres abroad.

The top of the table was dominated by smaller independent ISPs. John Lewis Broadband finished top of the pile on 76%, just ahead of perennial broadband award winner Zen Internet, with 75%. Utility Warehouse came third with 73%. The best three scored top marks for customer service and technical support. Zen was rated as the best of the three for speed but the worst for value.

"Smaller suppliers are leaving larger rivals in their wake when it comes to the service they provide so we need to see the big players up their game," said *Which?*'s executive director, Richard Lloyd. "Ofcom is also currently reviewing this market and we now need it to identify how it plans to ensure broadband customers get a better deal."

Humax to launch first Freeview Play boxes

HUMAX CLAIMS IT will be the first manufacturer to launch set-top boxes based on the forthcoming Freeview Play service. Freeview Play is, as the name suggests, a free-to-air on-demand and catch-up television service and is expected to launch this summer.

The Freeview Play line-up will include BBC iPlayer, ITV Player and 4oD, and will allow viewers to browse backwards through the electronic programme guide (EPG) and stream shows on-demand if they missed the live broadcast.

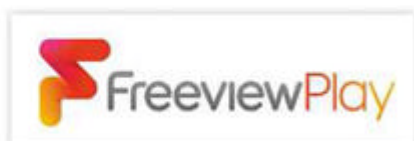
Humax says it will offer two versions of its Freeview Play set-top box: a 500GB model that stores 300 hours of television and a 1TB version that can store 600 hours. The boxes will include Wi-Fi receivers for accessing the internet television services.

Details are otherwise sparse, with Humax saying it will reveal more details about the precise specification of the boxes and prices closer to the launch date "in the coming months".

Freeview Play is set to be built into smart televisions as well as set-top boxes. Panasonic previously announced plans to incorporate Freeview Play in its Viera range of smart televisions, and says it too will launch set-top boxes later.

Play will allow Freeview to make up lost ground with rival YouView, which has offered features such as on-demand playback and rewindable EPG in its YouView boxes for some time. The YouView platform has come to be dominated by BT and TalkTalk, both of which offer set-top boxes to customers who sign up for television services with their broadband. BT is in the process of moving its BT Vision customers to YouView and was recently helped by a court decision forcing Sky to offer BT some of its sport channels for YouView customers.

Freeview is supported by a wider range of manufacturers that embed the free-to-air service into their own equipment. Freeview manufacturers have greater control over the user interface they offer their customers, whereas YouView boxes all offer a relatively uniform interface designed and modified by YouView itself.



Nintendo to develop smartphone games

NINTENDO IS TO develop games for smartphones and tablets after signing a deal with DeNA, a Japanese mobile gaming company, that could see Mario appear on the iPhone and other mobile platforms.

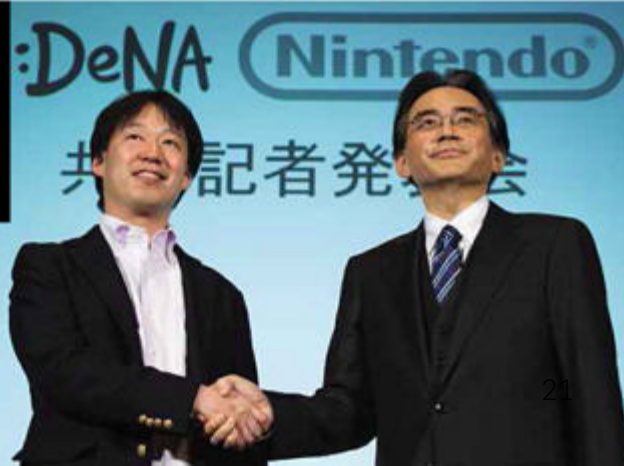
Nintendo has been fiercely protective of its much loved gaming franchises, reserving them almost exclusively for its own hardware. Now the company is loosening the apron strings, potentially bringing Mario, Zelda and other legendary characters to third-party mobile devices.

Nintendo president Satoru Iwata announced the partnership at a press conference in March, confirming that the companies will play a joint role in developing the new games. While most of the development will take place at Nintendo, DeNA will help the company build its online presence and provide back-end support with its extensive server infrastructure.

Those hoping for direct ports of classic titles such as Mario Kart will be disappointed, however. "We have no intention at all to port existing game titles for dedicated game platforms to smart devices because if we cannot provide our consumers with the best possible play experiences, it would just ruin the value of Nintendo's IP," Iwata said.

The first games are expected later this year, although both companies are keeping tight-lipped as to which titles we can expect to see. Nintendo isn't giving up on making its own hardware, though, as Iwata also revealed the codename for its next games console: the Nintendo NX. Nintendo promised a full announcement about the NX next year. The Nintendo NX will also tie in with a cross-platform online membership scheme that Nintendo and DeNA plan to launch this autumn. This will replace the existing Club Nintendo membership scheme which Nintendo announced it will be closing, and will encompass the Wii U, 3DS, PC and Nintendo NX.

With Nintendo's new partnership with DeNA, we could see Mario and Zelda games appearing on smartphones before Christmas



BT goes mobile with 4G deals

In advance of its EE takeover, the two companies are already collaborating

BT HAS UNVEILED a range of low-cost 4G tariffs as it makes its return to the mobile market more than a decade after selling its mobile division, O₂. The company is offering a selection of SIM-only tariffs with big discounts for existing BT broadband customers. Piggy-backing on the EE network, BT's new service offers the same coverage but at cheaper rates. Here's everything you need to know about the UK's latest mobile service.

TARIFFS

BT is keeping its tariffs simple with just three plans. The cheapest deal offers 500MB of data, 200 call minutes and unlimited texts for only £5 per month to existing broadband customers, or £10 otherwise. A mid-range tariff boosts the data cap to 2GB and gives 500 call minutes for £12 per month (£17 for non-BT customers). At the top end, you can get 20GB of data and unlimited minutes for £20 per month (£25 for non-BT customers). All tariffs include unlimited access to BT's Wi-Fi hotspot network, which BT broadband customers already get for free anyway. Tethering isn't permitted on any of the tariffs, despite the fixed data caps.

None of the deals includes a handset, although BT offers a thin selection of four low- to mid-range phones from £99, including a discount for existing BT customers.

All the deals are subject to a 12-month contract, but BT says customers can move between tariffs – even cheaper ones – without

penalty. Customers can only downgrade once during their contract period, however.

"You can upgrade at any time, and downgrade once during your contract," said Kelly Barlow, director of voice and mobile at BT. "We'll send you usage alerts and recommend you a different plan if we think you're better off on it."

ROAMING

Roaming is one area where you don't get as good a deal as with other networks. At the moment, BT offers only standard roaming charges. In the EU, for example, calls cost 18.8p per minute, data is 19.8p per megabyte and SMS messages cost 5.9p each. EE has the same standard charges but also offers data and call bundles: unlimited calls in Europe cost £2 a day, for example. Other networks offer similar deals, while Three lets you use your standard allowance abroad in a growing number of countries with its Feel At Home service. Barlow told us that similar bolt-on bundles are something BT is "looking at for the future".

At least BT has its own SmartTalk app, which lets users make calls over Wi-Fi and charges them to your landline account. Using this, you can make cheap phone calls over a Wi-Fi network when you're abroad.

The BT service is piggybacking on the EE network, but the highest speeds are

limited to EE customers. That means the double-speed 60Mbit/s and 4G+ 90Mbit/s services (the latter requires handset support) are not available to BT customers. Instead, BT Mobile runs on the regular 30Mbit/s service. We don't see that as a big issue and the standard 4G service is plenty fast enough for most people.

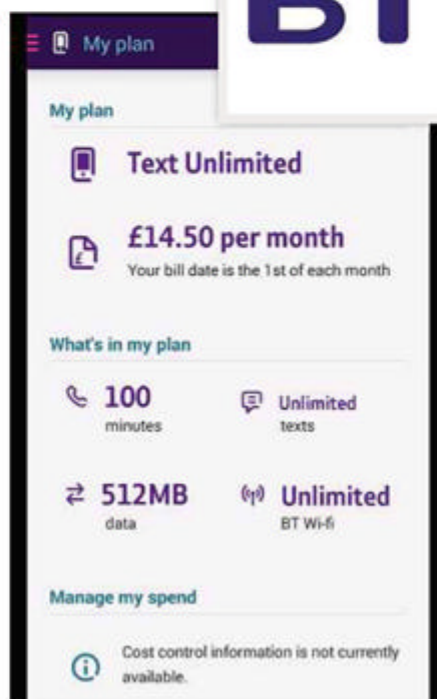
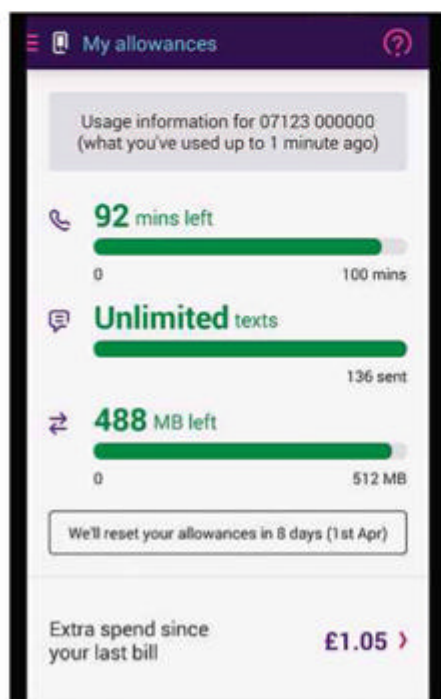
WI-FI AND VISUAL VOICEMAIL

BT Mobile doesn't currently offer the same range of features as EE, such as Visual Voicemail for iPhone. This isn't a key feature, though, and plenty of other networks don't support it. Besides, BT Mobile customers get free calls to standard voicemail. BT also lacks support for Wi-Fi calling, which will come to EE with the Samsung Galaxy S6. This lets you make and receive mobile phone calls while on a Wi-Fi network. At least BT's SmartTalk app lets users make some calls over Wi-Fi.

It also looks as if BT has failed to get its proposed "inside out" technology to work for this initial release. BT had planned to use its network of Wi-Fi hotspots to handle calls and data, falling back on EE's mobile network when customers moved out of Wi-Fi range. However, the company reported teething problems the technology last year.

All BT Mobile customers get free access


to BT Sport via an app, even if they don't subscribe to BT Broadband. The company also has iOS and Android apps for managing your account, checking your current usage and putting caps in place if you wish.



EE TAKEOVER

BT is in the process of buying EE for a proposed £12.5 billion, and says it will "reveal more details after the deal completes about what [EE] customers will be offered". The process could take many months, however, as the competition authorities are likely to be poring over the details of the takeover.

BT chief executive John Pether described the new tariffs as a "great way to start our journey towards re-establishing ourselves as a major player in consumer mobile". If its takeover of EE is approved, that journey will be a short one, with BT instantly becoming the biggest mobile network in the UK.

For the time being, there's no doubt that BT Mobile is excellent value and highly competitive, particularly if you're already a BT Broadband customer and you've got your own handset. We'll be getting a SIM soon to give the service a thorough testing. 

▲ BT has its own app that helps you keep track of your allowances and any additional money spent

How fast is the new MacBook?

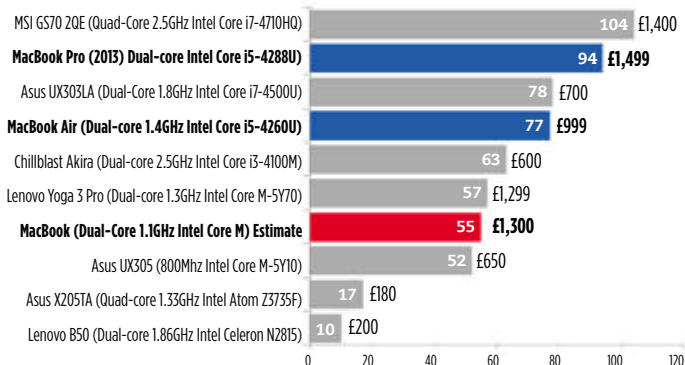
Is Apple's latest just a £1,300 netbook? We see how it stacks up against the competition

APPLE'S NEW LAPTOP made the headlines when it launched alongside the Apple Watch. Apple has simply named it MacBook, which may be confusing, but thanks to its wafer-thin (13mm) and light (0.9kg) chassis, fanless cooling and single USB type-C port, it won't be easily confused with other models. One of the main reasons the laptop is so thin and light is that it uses an Intel Core M processor – but how quick is this ultra-mobile chip in real-world use?

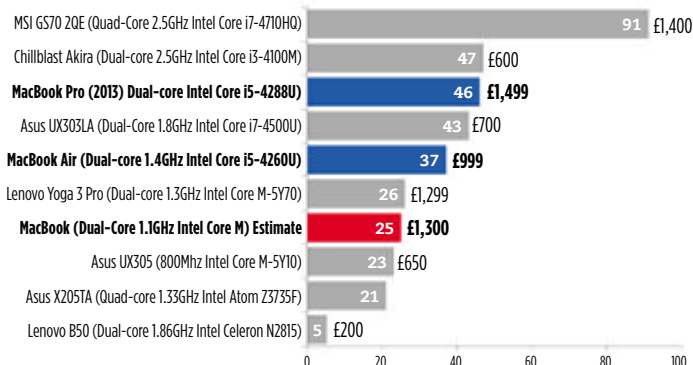
Intel's Core M processors are based on a 14nm manufacturing process. The result is a range of processors with low clock speeds but equally low power consumption and heat output. Some of the new chips even run at less than 1GHz – which may leave some consumers worrying that the new, expensive MacBook is more like a netbook.

To see how quick the new MacBook will be, we've tested laptop processors from across the board, including two Core M chips and a variety of processors from budget to high-end.

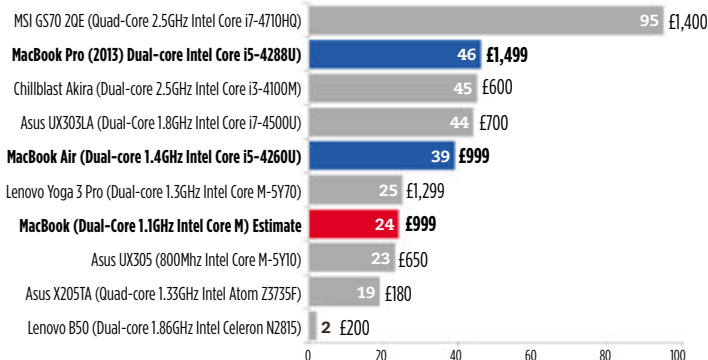
Image editing



Video encoding



Multitasking



We've estimated how Apple's 1.1GHz MacBook will perform, based on results obtained from other laptops running Core M chips. Other factors such as cooling, RAM and hard disk speed will have a small effect, but for our purposes the scores are accurate enough to give a good idea of how the MacBook will perform. We've only made estimates for the 1.1GHz MacBook, but a choice of three Core M chips will be available when the laptop goes on sale: 1.1GHz (2.4GHz Turbo Boost), 1.2GHz (2.6GHz Turbo Boost) and 1.3GHz (2.9GHz Turbo Boost).

In our tests we measure how long each laptop takes to complete a set of benchmarks, including image editing, video encoding and multitasking tests. A desktop Intel Core i5-3570K PC scores 100.

IMAGE CONVERSION

This is the most important test for the MacBook because, while it's an expensive laptop, its light, thin design means it'll mostly be used for basic tasks on the move, and not processor-crunching activities such as video editing. Not surprisingly, the powerful quad-core Intel Core i7 processor in the MSI GS70 gaming laptop leads the field, followed by the 2013 MacBook Pro's Core i5. The MacBook Air also performs well here, thanks to its dual-core Core i5 with Hyper-Threading.

The New MacBook's estimated score sits just behind the mid-range Core i3 in the Chillblast Akira and the 1.3GHz Core M in Lenovo's Yoga Pro 3, with 55. This is decent performance, and while it's some way off that of a cheaper MacBook Air, that's the price you pay for the thin design. In real use, the laptop will be fine with simple tasks such as editing documents, watching videos and browsing web pages.

In comparison, the Asus EeeBook X205TA, with its quad-core Intel Atom processor, scores 17. It's slow but it's not as frustrating to use as the low score suggests, and we had no trouble running basic programs on this netbook-like device. With a score three times higher than the Asus, the MacBook will cope fine with normal desktop applications.

VIDEO ENCODING


This test challenges laptops to crunch a Full HD video into a smaller file. It takes a lot of processing power and favours processors with more cores. As you can see from the graph, processors with only two cores struggle, hence the gulf between the MSI laptop and everything else. The MacBook looks somewhat slower here and will take an age to convert videos, render 3D objects and conduct other intensive tasks. It's not massively far behind the MacBook Air in this test, however.

MULTITASKING

In the multitasking test the laptops simultaneously convert images, encode video and play a film. As a result, the spread is similar to that in the video encoding test, as this is the most challenging aspect.

Our hypothetical MacBook performs relatively modestly here. You can also see the ultra-cheap Lenovo B50, one of the slowest laptops we've ever tested, taking up its usual spot at the bottom of the graph.


VERDICT

The MacBook is certainly no netbook, although you should understand that it's currently impossible to reach even a MacBook Air's performance with something this thin and light. If you value portability over all else, the new MacBook is hard to beat and should be powerful enough for most tasks, but if you need serious power you'll need to look elsewhere. 

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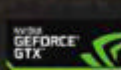
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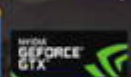
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REVIEWS

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GAMING LAPTOP WITH EXTERNAL GPU

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13 and Graphics Amplifier



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VERDICT

An attractive, powerful compact gaming laptop, but its optional external GPU needs a lot more work

THE ALIENWARE 13 replaces the 14in model as the smallest laptop in the company's range. It's a dinky mid-range gaming laptop with the option to upgrade its graphics using an external GPU.

Alienware's signature design works well on this scale, though the dark grey finish with LED lighting may not be to all tastes. AlienFX software lets you customise eight backlight zones, including four on the keyboard and the alien head logos on the front and back. Things are even better when you open the lid, with a soft-touch, grippy black plastic coating the palm rest. It picks up greasy marks easily, but it's comfortable and looks attractive enough.

The keyboard is up there with the best we've used. The keys are large, with plenty of grip and travel, which makes them equally suited to gaming and typing. The touchpad is extremely responsive, with buttons that don't interfere with the cursor.

SLIM PICKING

While far from being the most portable 13in laptop on the market, the Alienware 13 is slightly lighter and 5mm thinner than our favourite 13in gaming laptop, the Chillblast Defiant 2 Mini, although Chillblast's machine is much cheaper and somewhat better specified. Still, Alienware's build quality trumps most off-the-shelf models.

Of the three models in the range, two use Intel Core i5 processors and the third has a Core i7. We tested the mid-spec model, which has a Core i5-4210U dual-core processor and 8GB of RAM. It's hardly the

most potent processor around, running at a base clock speed of just 1.7GHz. It managed an overall score of 33 in our benchmarks, peaking at 62 in our image-editing test but dropping to a leisurely 19 in the multitasking test. It's snappy when using Windows 8.1, but it may prove to be a slight bottleneck with the latest games.

Where this lack of power does help the Alienware 13 is in its battery life; it managed a staggering 7h 18m in our moderate usage test: almost unheard of for a gaming laptop. Of course, expect battery life to be reduced significantly if you plan to play games on the move.

The Nvidia GeForce GTX 860M dedicated graphics card has 2GB of memory and is still a great GPU despite its age. Considering the newly announced 960M is essentially the same GPU with a slightly bumped clock speed you aren't missing out on any extra performance. It managed a respectable 32.8fps in Dirt Showdown at 1,920x1,080 resolution, Ultra settings and 4x anti-aliasing.

Metro: Last Light Redux was more of a struggle: the Alienware 13 managed only 15.5fps at 1080p. However all but the most powerful GPUs find this test tough, so it's still a

reasonable result. Disabling supersampling anti-aliasing and tessellation resulted in a much more playable 37fps average.

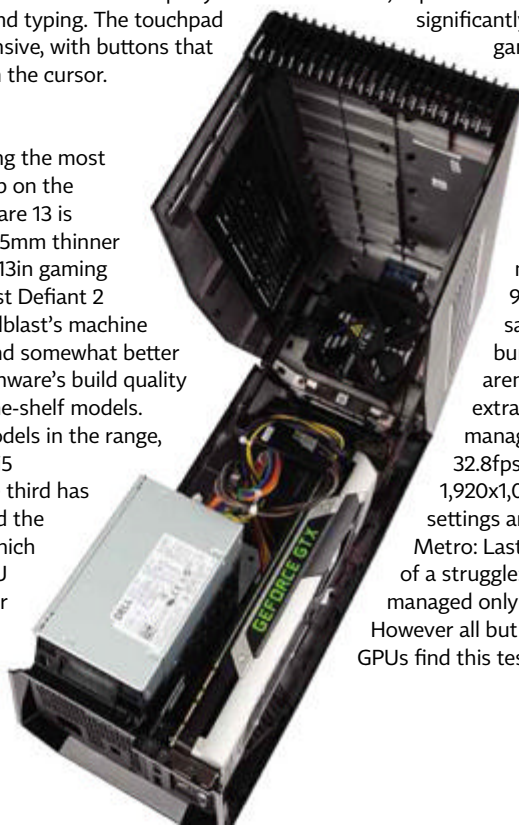
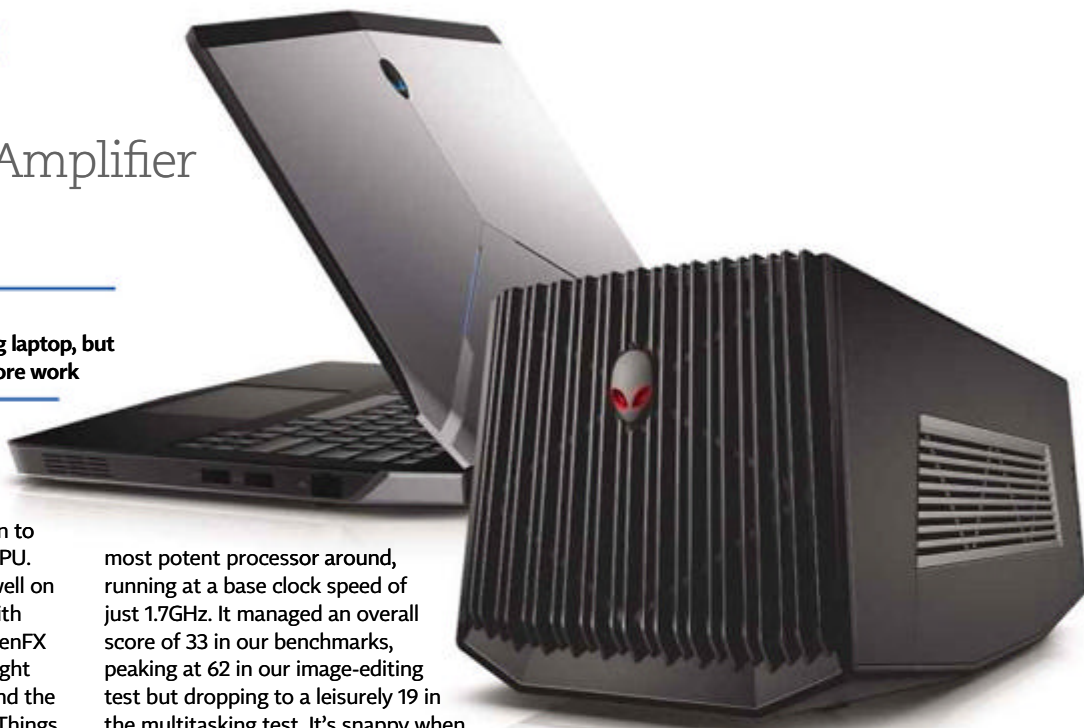
Noise while gaming isn't extreme and the exhaust fans maintain a steady whooshing noise that is easily overcome by headphones or speakers. The built-in speakers are actually reasonably good, too: there's a degree of stereo separation and a small amount of bass presence, so if you don't have any alternative you won't be left with poor quality audio.

QUITE A CONTRAST

The Full HD screen is decent enough. While 88.8% sRGB colour gamut coverage won't set the world alight, the 1,182:1 contrast levels and very bright 309cd/m² whites mean this screen will do justice to your games and movies, particularly in darker scenes.

You get three USB3 ports, two 3.5mm audio jacks and a Gigabit Ethernet port on the side of the laptop, and a Mini DisplayPort and full-size HDMI port at the rear. This is also where you'll find a connector for the optional Alienware Graphics Amplifier.

The Graphics Amplifier is much shorter than a conventional PC chassis, but at 410mm it's longer than many microATX cases. It's easy to hide behind your monitor, which we would recommend; the cheap-looking black





p32 | HP Stream 11



p39 | Dell Venue 8 7840



p44 | Samsung U32D970Q



p56 | Synology DS215j



p62 | Homeworld Remastered

We faced a constant stream of Nvidia-related driver issues that made the Graphics Amplifier a pain to use

plastic is a far cry from Alienware's premium-looking designs and doesn't match the laptop. You can put it on the floor, as the cable is long enough to run from the floor up to a desk.

The proprietary cable acts both as a x4-speed PCI-E lane and a USB port replicator. All your peripherals, including the keyboard, mouse and monitor(s), plug into the USB and video output connectors, and are instantly available as soon as you switch the laptop on. It's not quite as convenient as a dock that you'd drop your laptop on to; you have to instead reach around the back of the laptop and connect the cable.

The base unit holds a PCI-E x16 slot and a 460W PSU, but you'll have to fit your own graphics card unless you pay the extra upfront. We'd recommend buying a graphics

card from another supplier, however, because Alienware charges through the nose. The PNY GeForce GTX 980 costs around £440 from UK retailers but Alienware charges £600, in addition to the Graphics Amplifier itself.

HIGH AND WIDE

Installing a graphics card should be easy, but despite Alienware claiming the Graphics Amplifier can accommodate double-height, full-length cards, we found several that wouldn't fit. The Asus Strix GTX 970, for example, was too wide, and the Sapphire R9 270X too thick. On both occasions we had to run our benchmarks with the case open. Annoyingly there's no easy way to find out which cards will fit, but as a rule cards with custom coolers are likely to cause problems.

We tested several graphics cards to see if performance was on a par with a conventional desktop. For the most part it was, with minor deviations mostly explained by the laptop-grade Core i5 processor. Performance will vary depending on your laptop's configuration.

It's a real shame, however, that we faced a constant stream of Nvidia-related driver issues that made the Graphics Amplifier a pain to use. The laptop would often continue to use its integrated graphics rather than the Graphics Amplifier when connected, fail to reactivate its own Nvidia graphics when disconnected, or ignore the Graphics Amplifier completely.

AMD has released dedicated drivers that worked reliably during our testing. That means you'll have to buy the Graphics Amplifier and graphics card separately, as currently only Nvidia cards are available via Alienware.

Alienware is working on a single unified driver that should solve these problems, but until it arrives the workarounds involve unsupported beta drivers that delete all pre-existing Nvidia data. Even then you may run into problems when disconnecting the laptop from the Graphics Amplifier.

PRICE TO PAY

The Alienware 13 is a beautifully designed and rugged-feeling gaming laptop that you can take anywhere. As is often the case with Alienware products, though, the price is just a little too steep considering the specifications. However, at this size we would be tempted to pick the Alienware 13 over any similarly sized rivals simply because it feels so well made. You also get Dell's excellent collect and return warranty, which includes in-home support should the firm decide it's required. If you don't have as much money to spend, though, the Chillblast Defiant 2 Mini remains our favourite compact gaming laptop.

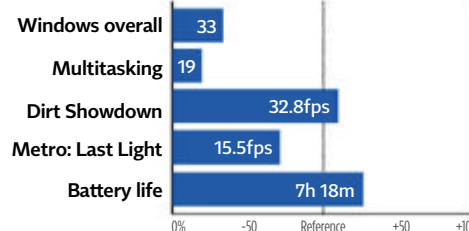
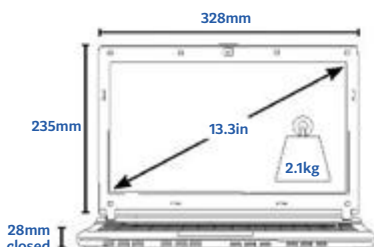
Whether the Graphics Amplifier is a must-have addition depends on whether you'll be using an AMD graphics card; until Nvidia and Alienware fix the driver issues it only really works with AMD hardware. If you're an Nvidia fan, it's best to wait until these problems are fixed before taking the plunge.

Michael Passingham



SPECIFICATIONS

PROCESSOR Dual-core 1.7GHz Intel Core i5-4210U
RAM 8GB
SIZE 328x235x28mm
WEIGHT 2.1kg
SCREEN SIZE 13.3in
SCREEN RESOLUTION 1,920x1,080
GRAPHICS ADAPTOR Nvidia GeForce GTX 860
TOTAL STORAGE 256GB SSD
OPERATING SYSTEM Windows 8.1
PARTS AND LABOUR WARRANTY One year collect and return
DETAILS alienware.co.uk
PART NUMBER N00AW309



See page 72 for performance details

SYBER Vapor K



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VERDICT

The Syber Vapor K is a no-compromise, living-room-friendly gaming PC that's surprisingly upgradable

WITH THE IMPENDING arrival of Steam machines, the living room has suddenly become the new battleground for PCs as manufacturers attempt to fit powerful components into tinier cases. Cyberpower's Syber gaming sub-brand focuses purely on this console-like PC experience.

The Vapor K is only console-sized if you're referring to the era of the original Xbox. It's certainly smaller than a typical mid-tower gaming PC, but will still take up a rather large amount of space underneath your TV.

The chassis has an overall shape that does somewhat hark back to the original Xbox. An exposed fan exhaust with no filter concerns us slightly, as dust has the potential to get inside when it's turned off. There are a few other minor design issues as well, such as the upside down USB ports on the front.

LIGHT BRIGADE

The Vapor K is available in white or black but you can customise it using a discrete button on the side, which cycles the strip of LEDs on the front though different colours. One of the settings turns the lighting off completely.

There are several customisable Vapor configurations with differing base specifications. Prices range from £499 to £1,249. The model we reviewed, the Vapor K, is available for £999, which makes it more expensive than the top-end Alienware Alpha.

The larger case does have its benefits, such as a more powerful graphics card. While



the Alpha used a graphics card based on a laptop GPU, the Vapor K can accommodate a proper desktop card in the form of an Nvidia GTX 970 with 4GB of GDDR5 memory. A desktop class Intel i5-4690K processor running at 3.5GHz is also used, along with 8GB of memory and a 2½in 1TB hard disk.

Performance is slightly above what we'd expect, with a score of 105 in our desktop test. This makes the Vapor K a decent choice for tasks beyond living-room gaming.

If you're looking for a system that will give games consoles a run for their money, the Vapor K did well here, too. Dirt Showdown at 1080p saw 112.8fps with Ultra graphics and 4x anti-aliasing. Tomb Raider saw a silky 64.9fps with 2x SSAA and Ultimate quality. In Metro: Last Light Redux the system produced 45.3fps with SSAA turned on, increasing to 77fps with SSAA off. The GTX 970 is a great performer.

While gaming and under load, the Vapor K is quite noisy, with the fans spinning quickly to keep the components cool. The chassis also becomes warm, so you'll need to make sure there is adequate ventilation.

OPENING UP

Upgrades are simple. A single screw hidden under a cap allows you to slide off the top cover. Both memory slots are occupied but you can easily swap these out to install up to 16GB of memory. The hard disk is mounted on a removable metal plate that also has a 120mm fan attached. This is installed over the

graphics card, so will need to be removed first if you want to swap out the graphics card.

There's a good array of connectivity, including a headphone and microphone port on the front of the system, something the Alienware Alpha lacks. In addition to the one USB and two USB3 ports on the front, there are four USB and two USB3 ports on the rear, along with a Gigabit Ethernet port and connections for an external Gigabyte 802.11ac Wi-Fi antenna. There are also audio connections for up to 7.1 surround and an optical S/PDIF connection. The graphics card has HDMI, DisplayPort and two DVI outputs.

The Syber Vapor K is a living room PC, so installing Steam and using Big Picture mode to navigate your gaming library is a must. Our system was set to auto-start Steam in Big Picture mode as soon as Windows booted, but this is something you can disable if you prefer to boot into a conventional desktop.

The Vapor K comes with a Logitech F710 wireless gaming controller that takes its cue from the PlayStation and Xbox controllers. The twin analogue sticks are positioned like the PlayStation's, but the face buttons use the distinct Xbox colours and labels. The F710 isn't a great controller; the triggers in particular aren't as responsive as we would like. We'd rather Syber had included an Xbox 360 controller and wireless adaptor instead.

KEY QUESTION

The wireless keyboard with integrated touchpad that also comes bundled with the system is no larger than a smartphone. The keyboard's keys are tiny but are a decent alternative to reaching for a full-size keyboard if you're on the sofa. The touchpad is also a welcome inclusion, but not something we would want to use for long periods of time.

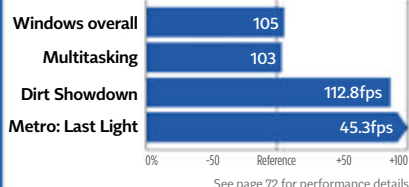
The Vapor K is a competent gaming PC in a compact form factor. It's not as small and innocuous as the Alienware Alpha but makes up for it with more power and easier upgrades. It runs a little hot and noisy for our liking, but overall the Vapor K is a fine choice if you want a living-room PC without compromise.

Richard Easton



SPECIFICATIONS

PROCESSOR Quad-core 3.5GHz Intel Core i5-4690K
RAM 8GB
FRONT USB PORTS 2x USB3, 1x USB
REAR USB PORTS 2x USB3, 4x USB
TOTAL STORAGE 1TB hard disk
GRAPHICS CARD MSI GeForce GTX 970 4GB
DISPLAY None
OPERATING SYSTEM Windows 8.1
WARRANTY Two years RTB
DETAILS www.cyberpowersystem.co.uk
PART CODE Syber Vapor K





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VERDICT

Super thin and light with sprightly performance, the Zenbook UX305 is a superb-value ultra-portable

INTEL'S CORE M mobile processors changed what we expect from ultra-portables in terms of performance and battery life. Even better, the chips can be found in laptops under £700.

The stunningly thin 1.2kg Asus Zenbook UX305 takes full advantage of the low power consumption and low thermal waste of its 0.8GHz Intel Core M-5Y10c processor. While 800MHz may sound pathetically slow, it can Turbo Boost to an impressive 2GHz when thermal conditions allow. If we hadn't known what processor was inside the laptop, we'd have guessed it was a Core i3.

The advantages of such a low-power CPU are clear. First, the laptop has no fans, so it's silent no matter how heavy the load. As a result, it's just 12.3mm thin and extremely light. The slim design means you're left with just a single Micro HDMI output, SD card reader, three USB3 ports and a 3.5mm audio jack, but that's a lot more than you'll get in the new MacBook. Asus also supplies a USB 10/100 Ethernet adaptor in the box for when you want to connect to a wired network.

METAL GURU

Asus hasn't skimped on build quality. The brushed metal chassis looks the part and, although it picks up greasy marks fairly easily and flexes a little, it doesn't feel flimsy. We were happy to throw the Zenbook UX305 into a bag without worrying about it getting damaged. At 1.2kg it's so light you'll barely notice it even in a small bag, so you can take this laptop anywhere even if you're not sure you're going to need it. It's this effortless practicality that so many laptops miss and the Zenbook UX305 manages perfectly.

The keyboard is comfortable to use with grippy island keys leaving plenty of space for your fingers. We had no problems with missed keystrokes and were able to type quickly whether on the bus, at work or with our feet

up on the sofa. The touchpad is good, too, and is improved by Asus' excellent Gesture Control software. This lets you switch various two- and three-fingered gestures on and off, and turn off the tiresome Windows 8 gestures that activate if you accidentally swipe your finger from the edge of the touchpad. Our favourite gestures are the three-fingered down swipe that shows the desktop and the three-fingered left and right gestures that take you back and forward in the browser. This brings the Zenbook UX305 in line with Apple's MacBook Air, which is equally easy to use thanks to similar gesture controls.

BLEEDING HEART

The screen is one area where a couple of build deficiencies come into focus. There's a small amount of backlight bleed at the bottom of the display where the panel looks to have warped slightly. It's not terrible by any means but it's the sort of build quality issue you'd find on a cheaper laptop. The 13.3in screen uses a Full HD panel, but it's not particularly stunning. While sRGB colour gamut coverage isn't great at 85.2%, the 1,368:1 contrast ratio means images still look good and fine details are visible. The matt screen has a 271cd/m² backlight and is visible even in brightly lit conditions, but this comes at the cost of fidelity: there's a slightly messy grain over the screen coating that is sometimes noticeable when looking at light greys and whites.

Performance isn't startling, but it's more than a match for basic tasks. The UX305 did well in our multimedia benchmarks, scoring 42 in the image-rendering test. The results from

the multitasking and video-compression tests brought its overall score down to a less exciting 22, but then you

shouldn't be buying a tiny ultra-portable for editing high-resolution video, so these results can be taken with a pinch of salt.

The Zenbook UX305 is about as far from a gaming laptop as you can get, but we ran our Dirt Showdown 720p graphics benchmark anyway, just to stretch the integrated Intel HD Graphics 5300. It managed 14.7fps at High settings and 4x anti aliasing, so you may get away with a few light 3D games.

THANKS FOR THE MEMORY

There's 8GB of RAM, too, so you're unlikely to run out of memory unless you open programs and browser tabs with reckless abandon. The laptop is pretty tightly sealed, so you won't be able to replace the RAM, 120GB SSD or battery without risking damage.

Battery life should be another strength of Core M-powered laptops, and while the 7h 24m the machine lasted in our laptop battery benchmark doesn't sound like much, you'll probably get through a full day's work if you're conservative with screen brightness.

The premium-feeling yet reasonably priced Zenbook UX305 is a great success. It doesn't tick every box – the screen isn't perfect and there are a couple of rough edges – but if you're looking for a nifty laptop for under £700, it's a great choice. It has more RAM, a thinner design and a higher-resolution screen than the MacBook Air, and it's also cheaper.

Michael Passingham



SPECIFICATIONS

PROCESSOR Dual-core 0.8GHz Intel Core M-5Y10c

RAM 8GB

SIZE 324x226x12mm

WEIGHT 1.2kg

SCREEN SIZE 13.3in

SCREEN RESOLUTION 1,920x1,080

GRAPHICS ADAPTOR Intel HD Graphics 5300

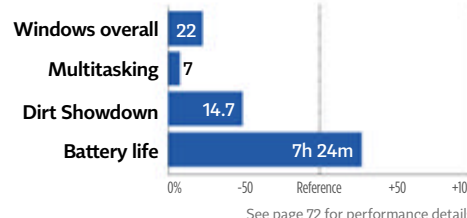
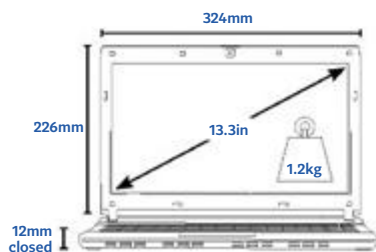
TOTAL STORAGE 128GB SSD

OPERATING SYSTEM Windows 8.1

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PC ADVISOR
Rating: ★★★★★



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SUB-£200 ULTRA-PORTABLE

HP Stream 11

★★★★★

£180 inc VAT • From www.currys.co.uk

VERDICT

A bargain laptop with lots of free cloud storage, but it's heavier than its closest rival

ASUS SURPRISED US last year with the EeeBook X205TA (see *Shopper 325*). The £180 ultra-portable was a bargain, particularly as it included one year of Microsoft Office 365, which is worth £60 alone. HP's Stream 11 offers pretty much the same deal: a sub-£200 price, a free year of Office 365, 1TB of OneDrive online storage and a pleasing design.

Whether you opt for a grey, pink or blue unit, the lid is made from one solid colour. The palm rest and keyboard tray have a dotted pattern and blue gradient that is perhaps a bit toy-like for our tastes. Build quality is great for the price, with the chassis not giving way to our prods and attempts to bend it. It's much heavier than the Asus EeeBook X205TA, though: the Stream 11's 1.3kg is a noticeable step up from the 980g Asus laptop.

The keyboard is decent enough. It fills up most of the keyboard tray, meaning it's spacious enough for people with fairly large hands. The white, island-style keys have a reasonable amount of travel and feel comfortable to type on for extended periods. Taps and swipes on the touchpad are responsive, too, although we had problems with the physical buttons. If you perform a physical click at the bottom-middle of the touchpad, you won't get a left- or right-click in Windows; you get nothing at all.

THREE'S COMPANY

The Stream 11 beats the Asus EeeBook X205TA in terms of connectivity, with a USB3 port in addition to a second regular USB port. This is useful for transferring large files from USB storage devices and even working directly off a high-speed USB hard disk, although you'll be wasting your year of free Office 365 if you do this. There's also a full-size HDMI port for connecting to a TV or external monitor.

The 1,366x768-pixel screen is usable in most reasonable conditions, although working outdoors will be a struggle as the backlight isn't particularly bright. Colour coverage is a meagre 62.1% of the sRGB colour gamut, which is admittedly better than the Asus, and contrast is rated at 325:1. Horizontal viewing angles are fairly wide, and with a bit of hinge adjustment, the viewing experience is perfectly adequate for such a cheap laptop.

The one year of Microsoft Office 365 included with every Stream 11 also includes 1TB of OneDrive storage, although



you'll have to budget £60 per year when the subscription expires if you want to continue using it. Office 365 includes Microsoft Office Online, which is an excellent web-based suite with more features than Google Docs. You can also install the desktop version of the Office suite on your PC as Office 365 includes a one-year licence for this, too.

You'll need to get used to working in the cloud: the spartan 32GB of storage makes this as close as Windows machines get to Chromebooks. Windows 8.1 isn't quite as well suited to working in the cloud as Chrome OS, although it's fairly easy to set up folders to synchronise with OneDrive.

HP hasn't clogged up the Stream 11 with unwanted software, either, although we would advise you to uninstall McAfee Internet Security suite as it's intrusive and restricts performance.

SINGLE MINDED

While the EeeBook X205TA uses a quad-core Intel Atom chip, HP has opted for a 2.16GHz dual-core Intel Celeron N2840. Neither laptop is particularly fast, but the Celeron is actually a little quicker when it comes to single-core focused tasks, such as basic web browsing. It scored 30 in our old benchmarking tests, 13 more than the Asus laptop. Its overall benchmark score of 15 is four points less than the EeeBook, though, which is largely due to our benchmark's multi-core focus. However, because you should only expect to be doing simple tasks on a budget laptop, the faster single-core speed of the HP Stream 11 makes it a better overall proposition.

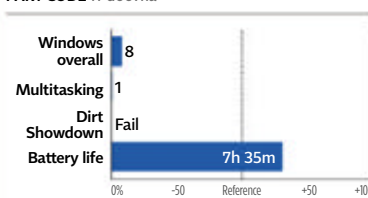
Battery life is great; we managed to get 7h 35m in our moderate usage test, so if you're conservative with screen brightness and media consumption you could realistically get through a full working day.

It's a close-run thing between HP's Stream 11 and the Asus EeeBook X205TA. The Stream 11 has a small performance advantage thanks to its higher clock speed, and the screen is marginally better. However, this comes with a significant weight penalty. Either way, both laptops are a steal at £180 and are well worth your cash if you're on a budget.

Michael Passingham

SPECIFICATIONS

PROCESSOR 2.16GHz Intel Celeron N2840
RAM 2GB
SIZE 300x206x20mm
WEIGHT 1.3kg
SCREEN SIZE 13.3in
SCREEN RESOLUTION 1,366x768
GRAPHICS ADAPTOR Intel HD Graphics
TOTAL STORAGE 32GB eMMC
OPERATING SYSTEM Windows 8.1 with Bing
PARTS AND LABOUR WARRANTY One year collect and return
DETAILS store.hp.com
PART CODE 11-d007na



LIVING-ROOM GAMING PC

ALIENWARE Alpha



£449 inc VAT • From alienware.co.uk

VERDICT

Delightfully small, but its console-like experience isn't as seamless as we would like

ALIENWARE'S PREVIOUS FORAY into the living room, the X51, was a great attempt at capturing an area dominated by the PS4 and Xbox One. It was powerful yet compact, but price was its downfall; it started at £599 and rose quickly as soon as you started upgrading from the base specification. The Alpha starts at a much more palatable £449, a price that is at first glance more acceptable relative to the competing games consoles.

The Alpha looks more like a set-top box than a games console. The small black chassis lies horizontally and is smaller than the PS4 or Xbox One. The Alienware logo and front left corner light up in your choice of colours, but they can be turned off. The overall design is rather subtle, which is a surprise considering Alienware's penchant for the outlandish.

PORTS OF CALL

The Alpha has two USB ports on the front and another two on the back, but only the latter are the faster USB3. An optical TOSLink connection is available, but the Alpha can output audio over HDMI. A second HDMI port acts as a pass-through, which is useful if your display has only one HDMI port. We connected a PlayStation 3 and had no latency issues. The Alpha has to be turned on to act as a pass-through, however. There's also a Gigabit Ethernet connection and 802.11ac Wi-Fi.

Upgrading components is surprisingly easy. Removing a few screws on the bottom lets you pop off the top cover, exposing two fans. One is for the non-upgradable graphics card, but removing the other exposes the CPU heatsink and RAM, both of which you can swap out. Removing the bottom cover lets you access the hard disk, which again can be popped out and replaced with another 2½in drive. An SSD would be a worthwhile upgrade over the standard 5,400rpm mechanical hard disk.

The base £449 model has a dual-core, 2.9GHz Intel Core i3-4130T processor, 500GB of storage and 4GB of RAM, but it's worth spending an extra £50 to upgrade to 8GB of RAM and a 1TB hard disk. You can specify up to a quad-core, 3GHz Intel Core i7-4765T CPU,



which takes the price up to £699, but also increases storage capacity to 2TB and RAM to 8GB. All specifications share the same Nvidia GeForce GTX 860M graphics card, which is a custom design based on a laptop GPU.

FAB CONTROLLER

While the Alpha is essentially a Windows 8.1 PC, Alienware has geared it towards living-room gaming with the Alpha UI, which lets you control settings via the bundled Xbox 360 controller. The system boots into this mode by default after the initial setup process.

You'll be reliant on game downloads and digital services as the Alpha doesn't have an optical drive. Even if you haven't bought all your games via Steam, you can import titles into the library so you have a unified source for loading them, which is convenient.

Steam's Big Picture mode is perfect for navigating with a controller. All the icons are large and even inputting text via the controller is made easier through a combination of the controller's analogue sticks and the face buttons to quickly select the correct letter. This is far quicker than manually scrolling across an onscreen QWERTY keyboard.

Big Picture mode is really a stopgap until Steam releases its own operating system, SteamOS, which is expected later this year alongside Steam Machine consoles. Alienware has somewhat pre-empted everyone with the Alpha, but has promised it will support the SteamOS when it's released. For now, Big Picture mode is a good compromise.

Gaming performance unsurprisingly won't rival a full-size PC with a powerful graphics card, but the Alpha still stands toe-to-toe with next-generation games. It achieved 42.7fps in Dirt Showdown at 1080p with 4x anti-aliasing and Ultra quality graphics, and 47.2fps at 1080p and maximum settings in Tomb Raider.

Metro: Last Light Redux is a much tougher prospect as it uses demanding super-sampling anti-aliasing (SSAA). With the game set at

1080p, SSAA on and Very High quality, the Alpha managed only 16fps. Turning off SSAA and dropping the quality to High produced an eminently more playable 39.8fps.

The Alpha UI aims to provide a console-like experience, but the Alpha is still a full Windows 8.1 system. You can access the desktop from the Alpha UI menu, but you'll have to sign into a different Windows account. The Alpha UI doesn't have any media-playing capabilities, so jumping between the two modes becomes an unwanted regular chore.

TASK MASTER

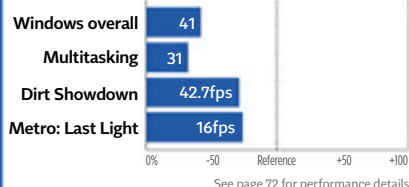
Desktop performance was middling, achieving only 41 overall in our tough new benchmarks. The Alpha is capable of most desktop tasks but don't expect it to be particularly quick when running more demanding applications.

Gaming performance is top-notch, but the promise of a console-like experience falls short. Forcing Windows 8.1 into the background isn't ideal when you still need it to play multimedia files, and booting into the Alpha UI takes a significant amount of time. As it stands, the Alienware Alpha has a lot of unfulfilled potential, but it will be interesting to see how it does with SteamOS in the future.

Richard Easton

SPECIFICATIONS

PROCESSOR Dual-core 2.9GHz Intel Core i3-4130T
RAM 4GB
FRONT USB PORTS 2x USB
REAR USB PORTS 2x USB3
TOTAL STORAGE 500GB hard disk
GRAPHICS CARD Custom Nvidia GeForce GTX 860M
DISPLAY None
OPERATING SYSTEM Windows 8.1
WARRANTY One year RTB
DETAILS alienware.co.uk
PART CODE Alienware Alpha



CURVED-SCREEN SMARTPHONE

LG G Flex 2



£500 inc VAT • From www.carphonewarehouse.com

VERDICT

The curved screen looks great, but an overly glossy chassis and mediocre battery life detract from the G Flex 2's appeal

THE SECOND GENERATION of LG's bendy smartphone has a concave screen that shares the same 700mm radius curvature as the company's TVs – allegedly making for a more immersive viewing experience. As the phone's name suggests, the screen bends and flexes when you apply small amounts of pressure to it. This is thanks to LG's flexible plastic substrate OLED (or P-OLED) panel, which is made from a thin film rather than a rigid sheet of glass. It's incredibly strong and survived being repeatedly squashed on to a table during our tests.

OLED technology makes the G Flex 2's 5½in, 1,920x1,080 display look stunning. With an sRGB colour accuracy score of 99.4%, colours were rich and vivid, with plenty of punch despite a rather low peak brightness of 324.79cd/m². This isn't necessarily a problem, as OLED screens tend to appear brighter than their LCD counterparts at this brightness level thanks to the thinner display layers inside the panel. As we'd expect from an OLED panel, black levels were a perfect 0.00cd/m² in our tests.

HOLLOW POINT

The display is first rate, but we're not convinced the curve adds any real benefits. The only advantage it has over its flat rivals is that the concave screen will never fall flat on the ground if you drop it, potentially leading to fewer shattered screens – but undoubtedly more smashed corners.

The 'self-healing' back panel didn't impress us, either. It's supposed to heal light scratches in as little as 10 seconds, but after carrying it in a bag with our keys for a few days, we'd made a couple of noticeable dents that failed to disappear. Unsurprisingly, anything more violent will leave permanent damage.

The plastic coating does a reasonable job of disguising any leftover scratches due to the sheer number of fingerprints it picks up, but when it catches the light every scratch is clear to see. This is a pity, but our biggest disappointment with the G Flex 2's back panel is how cheap and unattractive it looks. LG insists the G Flex 2 isn't a flagship

smartphone, but its high price says otherwise, and with so much chunky plastic on show, it doesn't look or feel like a high-end device.

We'd hoped the phone's huge 3,000mAh battery and energy-efficient OLED screen would be a winning combination, but battery life was a disappointment too. The phone still managed a respectable 11h 25m in our continuous video playback test, but the Samsung Galaxy Note Edge's 3,000mAh battery, for example, managed another two hours under the same conditions. Fortunately, the G Flex 2 charges quickly, reaching 50% from empty in just 40 minutes, so you won't have to wait long if you run out of juice in the middle of the afternoon.

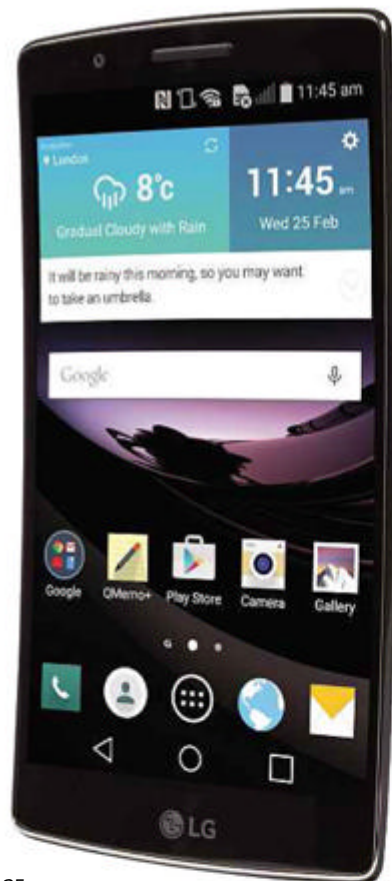
MOLTEN CORE

Performance was problematic at first, with the 2GHz octa-core Qualcomm Snapdragon 810 processor running extremely hot during our benchmarks. We thought it might be due to the 810's much-rumoured heat-dissipation problems. Thankfully, a phone software update made the benchmarks run much more smoothly, with little significant increase in the phone's internal temperature, leading to a much more stable set of results. The G Flex 2 scored 3,962 overall in PC Mark, putting it just behind other flagship phones such as Samsung's Galaxy Note Edge and Galaxy Note 4. Its web browsing score of 4,768 was particularly high – almost 1,000 points ahead of both Samsung handsets.

As a result, the G Flex 2 coped well with complex web pages and we were able to pan round and zoom in on articles with ease. We noticed a few stuttering animations on the Android 5.0 home screens, though, particularly when swiping out of its annoyingly immovable LG Health and Smart Tips panel.

Its graphics performance was also good, maxing out our 3DMark Ice Storm Extreme test and scoring a massive 23,959 (or an average of 113.4fps) in Ice Storm Unlimited.

This means it should have no trouble playing the latest 3D games, but we were surprised and slightly disappointed to see that it



managed just 50.7fps in our Epic Citadel test at Ultra High quality settings. This is still a great score, but we'd hoped for a near-perfect 60fps considering the capabilities of Qualcomm's new Adreno 430 GPU.

The G Flex 2 shares the same 13-megapixel camera as the LG G3 (*Reviews, Shopper 319*), so it comes with laser auto-focus, optical image stabilisation

and a dual LED flash. It was certainly quick to lock on to targets, but colours looked rather cool in our test shots. This made some of our photos look a little wintry, particularly in areas of shadow, but we were pleased to see very little noise, and areas of brickwork were pleasantly detailed.

Our main concern is the price. At £500 SIM-free, the LG G Flex 2 is one of the most expensive handsets you can buy, topping the G3 by almost £150. There's better news if you're after a new contract: Vodafone's £39.50 Red 4G deal has an up front cost of £19 but is arguably better value in the long term, as you get unlimited minutes and texts and 4GB of 4G data on top of six months of Spotify, Now TV or Sky Sports Mobile TV.

Good deals shouldn't distract from what's ultimately a fairly average handset, however. It's a little too expensive to contend with Samsung and HTC's latest phones, and we'd sooner buy cheaper G3.

Katharine Byrne

SPECIFICATIONS

PROCESSOR Octa-core 2GHz Qualcomm Snapdragon 810
SCREEN SIZE 5½in
SCREEN RESOLUTION 1,920x1,080
REAR CAMERA 13-megapixel
STORAGE 16GB
WIRELESS DATA 3G, 4G
SIZE 149x75x9.4mm
WEIGHT 152g
OPERATING SYSTEM Android 5.0.1
WARRANTY One year RTB
DETAILS www.lg.co.uk
PART CODE H955





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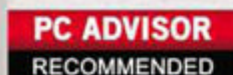
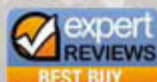
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VERDICT

The camera isn't great, but the new Moto E is still good value, with a bigger, better screen, faster internals and a longer-lasting battery

THE SECOND-GEN Moto G may be the best smartphone you can buy for under £150, but the new Moto E could be your best bet if you want something even cheaper. The surprise successor to Motorola's cut-price handset costs a bit more than last year's model – £109 SIM-free rather than £90 – but you get a lot more phone for your money: 4G support, a bigger, better screen, a faster quad-core processor, a front camera, more storage and Google's latest OS, Android 5.0 Lollipop.

The new Moto E looks like a bigger version of the original E, and its strong unibody chassis makes it one of the best-made budget phones we've seen. The only major difference is that you can now detach the phone's frame rather than just the back panel. Swapping it for different coloured bands or transparent grip shells adds some style and personality. You'll find slots for a micro SIM and microSD card under the band, and you can expand the phone's 8GB of storage with a 32GB card.

We're pleased to see some of Motorola's premium features make their way down to the new Moto E, too. Moto Display, for instance, shows the time and small notification icons when you pick up the phone with the screen off. You can jump to the notifications by sliding your finger up toward the top of the screen, or ignore them by swiping left or right. Admittedly, the Android 5.0 lock screen does something similar, but it's nice to be able to see the time without having to press any buttons.

Sadly, the new Moto E's Moto Display is nowhere near as responsive as on the Moto X, as the handset often wouldn't register that we'd picked it up. This is a shame, as it's by far one of our favourite Motorola features and, if it were on par with the Moto X, would give the Moto E a serious advantage over the Moto G, which doesn't support Moto Display.

TRACK SUITE

Moto Alert makes a welcome return, and is handy for parents who buy the Moto E for a child, as it lets them know where the phone is. Follow Me, for instance, sends the current location to select contacts at specified intervals, so concerned family members know where you are. Meet Me, on the other hand, sends texts to contacts telling them where to meet you. Lastly, Emergency sounds an alarm, auto-dials a chosen emergency contact

number and sends a text alert to tell them you're in trouble. It worked well when we tried it so it should give you extra peace of mind if your child is out with friends unsupervised.

If you want to capture a photo quickly, you can twist the phone back and forth in your wrist to activate the rear-5-megapixel camera. Admittedly, the camera isn't fantastic, as our test shots alternated between looking muddy and overexposed depending on the lighting conditions. Detail was grainy at times, and the phone's HDR mode looked very harsh and washed out.

Fortunately, the rest of the phone has received several much-needed improvements. The faster quad-core 1.2GHz Qualcomm Snapdragon 410 processor and 1GB of RAM put it on par with mid-range phones such as the HTC Desire 620 (see page 38), which costs twice as much. With a SunSpider JavaScript score of 1,323ms and a PCMark score of 3,411, the Moto E is very quick for such a cheap phone. Its document writing score of 4,844 in PCMark is also one of the best we've seen. Web browsing was equally impressive, as we were able to load and scroll down web pages with hardly any lag, and panning and zooming in were judder-free.

A faster processor also means better graphics performance. The Moto E produced 23.1fps (or 5,344) in our 3DMark Ice Storm test. It will struggle with more complex 3D games, as it managed only 15.5fps (or 2,511) in Ice Storm Extreme, but these scores are still roughly five frames faster than the original Moto E, and we were pleased to see an average of 44.8fps in Epic Citadel on Ultra High quality settings.

POWER AND GLORY

Battery life is excellent, with the 2,390mAh battery lasting an incredible 13h 30m in our continuous video playback test with the brightness at 170cd/m². This is more than three hours longer than the original Moto E, which already set a fairly high battery life



standard for budget phones. It's an outstanding result for a phone of this price, and gives the second-gen Moto G a run for its money.

The Moto G still has a few advantages. Its larger 5in 1,280x720 screen is easier on the eye than the Moto E's more compact 4½in 960x540 display. Desktop sites were hard to see on the Moto E without zooming in, and viewing angles weren't particularly wide either.

The Moto E's screen is good, however, with sRGB colour gamut coverage of 95.2%. Blue and magenta were a little short, but the rest of its colour coverage was evenly spread across the gamut, producing warm, vivid colours. Blacks were deep at 0.35cd/m², while its contrast ratio of 1,010:1 meant images showed lots of detail in light and dark areas.

The Motorola Moto E (2nd Gen.) is a fantastic budget smartphone. It may not have the best camera and the Moto apps could be easier to set up, but with 4G, fantastic battery life and Android 5.0, it's a great-value handset and a more viable alternative to the 3G-only second-gen Moto G than its predecessor.

Katharine Byrne

SPECIFICATIONS

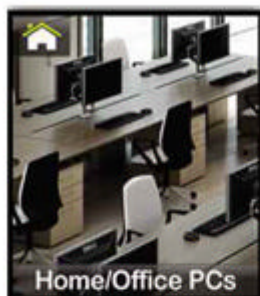
PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 410
SCREEN SIZE 4½in
SCREEN RESOLUTION 960x540
REAR CAMERA 5-megapixel
STORAGE 8GB
WIRELESS DATA 3G, 4G
SIZE 130x67x12.3mm
WEIGHT 145g
OPERATING SYSTEM Android 5.0.2
WARRANTY One year RTB
DETAILS www.motorola.co.uk
PART CODE XT1505



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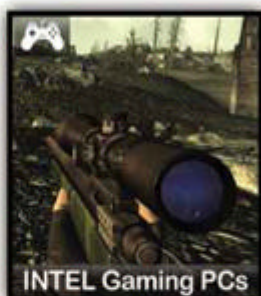
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MID-RANGE SMARTPHONE

HTC Desire 620



£191 inc VAT • From www.expansys.com

VERDICT

The HTC Desire 620 is a well-made smartphone with a good camera, but its poor screen and mediocre battery life hold it back

THE HTC DESIRE 620 is surprisingly large given its 5in screen. At 150mm high, it's almost a centimetre taller than Motorola's 5in second-gen Moto G, and isn't far off HTC's own Desire Eye, which stands at 152mm and has a larger 5.2in screen. The 620's size is partly to make room for HTC's BoomSound speakers at the top and bottom of the handset, but the bezels round the edge of the screen are quite large, adding a lot of empty space to its overall bulk.

This isn't surprising, as last year's Desire 610 used exactly the same design. However, while the Desire 610 looked rather cheap and tacky, with copious glossy plastic, the Desire 620 has a soft-touch matt chassis that not only looks much smarter than its predecessor but also feels much better made.

This makes the added height less of a problem, as the phone is comfortable to hold and the superb build quality is more in keeping with its price. Our grey and white review model isn't the most attractive colour combination, but others are available. Not all have a matt finish, but the additional colours add some personality.

The camera's HDR mode is impressive, bringing more detail into our shots without making colours appear too harsh

The larger, higher-resolution 5in 1,280x720 screen is another welcome improvement over the 610's grainy 4.7in 960x540 display, as text, icons and web pages are much easier to read. We didn't have to zoom in so often to read desktop websites, and HTC's Sense 6.0 UI looked sharper and more defined when flicking through Android 4.4's home screens.

Sadly, image quality has actually worsened from last year. Our colour calibrator showed that the 620's screen was displaying a measly 76.5% of the sRGB colour gamut. This is one of the worst colour accuracy scores we've seen in recent months, as the vast majority of handsets tend to hit around 90%.

Blues and yellows were strong, but the 620's green and red coverage were both deficient, so colours lacked depth and looked cool overall. Contrast was also a little below average – we measured a contrast ratio of 682:1, so images were less detailed than we'd like and viewing angles were slightly narrow.

With a peak brightness of 320.19cd/m², the screen is reasonably bright, but we had a bit of trouble seeing it clearly outside, so you'll need to have the screen on maximum brightness if you want to use it in bright sunshine. The screen's brightness brings the downside of producing rather grey-looking blacks, however, which was confirmed by our high black level reading of 0.46cd/m². Text on web pages looked a little pale, but it didn't cause too many problems during our tests.

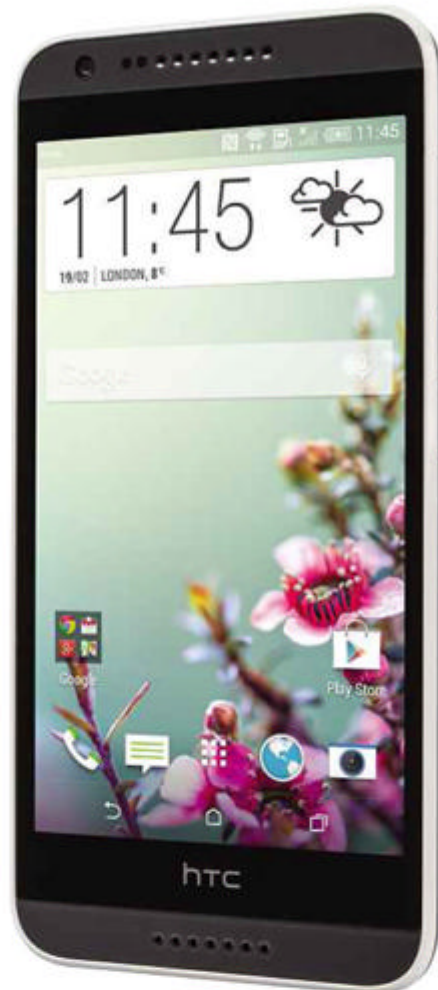
The Desire 620 is powered by a quad-core Qualcomm Snapdragon 410 processor running at 1.2GHz, paired with 1GB of RAM. This produced noticeably faster benchmark results than last year's Snapdragon 400 chip, scoring 1,073ms in SunSpider JavaScript and 3,118 overall in PCMark. The 620's video playback score was particularly high at 4,122,

putting it just behind last year's top flagship phones. In practice, however, we noticed the odd judder and delay when swiping up and down web pages, which did get frustrating.

Graphics performance wasn't quite as good as we expected. The Desire 620 produced an average of just 21.7fps (or 5,046) in our 3D Mark Ice Storm test and a stuttering 15.1fps (or 2,503) in Ice Storm Extreme. In Epic Citadel, it managed an average frame rate of only 30.2fps on Ultra High Quality settings, which is significantly slower than the 49.2fps produced by last year's Desire 610.

Battery life was shorter too, as the Desire 620 lasted only 9h 42m in our continuous video playback test with the brightness set to 170cd/m². This should still be enough to get you through the day, but when the Desire 610 lasted just over 11 hours, we were hoping for a little more from its successor.

Fortunately, the Desire 620's 8-megapixel camera was more impressive, capturing plenty of detail in our test



shots, as well as bright, accurate colours. It had a slight tendency to overexpose the sky and clouds in very bright conditions, but overall we were pleased with the quality of our photos. The camera's HDR mode was also impressive, bringing even more detail into our shots without making colours appear too harsh or grainy. The sky was also exposed much more accurately in this mode, so we'd recommend leaving it active when shooting outside.

The HTC Desire 620 may be much better made than last year's model, but it's a step down in almost every other category. It has a decent camera, but there are plenty of cheaper phones that offer much better value, such as the second-gen Moto G and even the latest Moto E (see page 36).

Katharine Byrne

SPECIFICATIONS

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 410
SCREEN SIZE 5in
SCREEN RESOLUTION 1,280x720
REAR CAMERA 8-megapixel
STORAGE 8GB
WIRELESS DATA 3G, 4G
SIZE 150x73x9.6mm
WEIGHT 160g
OPERATING SYSTEM Android 4.4
WARRANTY One year RTB
DETAILS www.htc.com
PART CODE Desire 620



See page 72 for performance details



DELL Venue 8 7840

COMPUTER
SHOPPER

★★★★★

RECOMMENDED

£320 inc VAT • From www.dell.com/uk

VERDICT

The Venue 8 7840 is a super-stylish Android tablet with an innovative camera

WE HAVEN'T SEEN many Android tablets from Dell. The company's last attempt – the Venue 8 Android – was highly competent but hardly set our hearts aflutter. The Venue 8 7840 is different. It's a truly desirable Android tablet with a gorgeous slim aluminium chassis and a super-high-resolution AMOLED display.

At just 6.1mm thick, the metal chassis is cool to the touch, and the rounded corners don't dig into your hands. The screen has slim bezels on three sides, but the bottom bezel is significantly larger. This is where you'll find two of the tablet's party tricks: incredibly loud MaxxAudio speakers and three cameras for Intel's RealSense depth aware cameras.

RealSense uses three cameras to measure depth in photos. This gives you access to fancy effects such as selective focus, the ability to apply effects to certain areas of the photo and even to measure the length and area of various objects in the frame.

The main camera sits at the bottom of the tablet with the two depth cameras above it. This immediately causes a problem, as your hand will probably obscure the camera whether you hold it in portrait or landscape

significant artefacts around the edge of the main subject. Edits are non-destructive, as the original image is kept in the tablet's DCIM folder. Distance judging wasn't quite up to scratch, however. In one test photo, the camera was convinced that a toy samurai warrior one foot from the camera was taller than a person standing eight feet away, which rather messed up the artistic effect we were trying to achieve.

The measurement tool is potentially very useful. It can measure the distance between two points or the area of an object, so could be handy for anything from working out someone's height to seeing if the sofa you like will fit through your door. Results were mixed, though, and we couldn't find a way to measure in metric rather than imperial units. We managed to measure a person accurately when they were standing bolt upright, but a 12in ruler was around three inches out, and one side of a painting was measured as twice as long as another. It's generally an impressive system, but it relies on the application of common sense and should be used only to get an idea of measurements.

The Venue 8 7840 is a truly desirable Android tablet with a gorgeous slim aluminium chassis and AMOLED display

mode. We found the best way to take a photo was to grip the tablet with our fingertips, but this meant we obscured some of the screen.

The camera's basic image quality didn't blow us away. Daylight images showed accurate contrast but significant noise, and noise reduction led to some smudginess. Low-light photos were nothing special either and we had trouble taking a sharp, shake-free shot under indoor lighting.

We had some fun with the depth sensors, however. Once you've taken a photo, you can use the app to make adjustments using the depth information captured by the secondary sensors, although you have to exit the camera app to select an image to edit, which is annoying. We particularly liked the ability to drain colour from an image depending on how far objects were from the camera. We turned a group of three people – with each standing slightly behind the other – into two people and a ghostly black and white apparition.

Selective focus works well enough, but apply too much of the effect and you'll see

Fancy camera aside, the Venue 8 7840 is an impressive tablet. The screen displays 100% of the sRGB colour gamut and, as it's an AMOLED model, blacks are truly black. The operating system feels as if it's just under your finger, and icons and text look sharp, clear and vibrant. With a maximum brightness of 262cd/m², however, the screen isn't as bright as other AMOLED displays, such as the Samsung Galaxy Tab S 8.4's (see *Group Test, Shopper 320*), which scored 297cd/m².

The tablet's quad-core 2.33GHz Intel Atom Z3580 processor performed well in our benchmarks. It managed a fast 864ms in the SunSpider JavaScript test, but we noticed some lag when scrolling around web pages and occasional stuttering in animations when opening and closing apps. The tablet managed a huge 20,415 in the 3DMark Ice Storm Unlimited benchmark and was able to play Blizzard's Heartstone smoothly apart from some jerky intro animations. The tablet currently runs Android 4.4.4, but Dell has promised an imminent update to Android 5



Lollipop, which should smooth out some of the performance bumps. In our battery test we saw 14h 20m, which is up there with the best tablets we've seen, such as Apple's iPad Air 2 (see *Group Test, Shopper 324*).

Although we had fun testing it, the Dell Venue 8 7840's depth-sensing camera feels like more of a gimmick than a reason to buy. This isn't a problem, as the tablet itself is a desirable piece of kit, with lovely build quality and an excellent screen. It's not the quickest tablet we've seen, however, and has serious competition from the Samsung Galaxy Tab S 8.4, which isn't as beautifully made as the Dell tablet but has a brighter AMOLED screen and costs just £250. There are also rumours that the Samsung tablet will get its update to Android Lollipop in April.

It may not beat the Samsung competition for value, but if you want a tablet that you can really show off, the Dell Venue 8 7840 is a good choice. It wins a Recommended award.

Chris Finnamore

SPECIFICATIONS

PROCESSOR Quad-core 2.33GHz Intel Atom Z3580
SCREEN SIZE 8.4in
SCREEN RESOLUTION 2,560x1,600
REAR CAMERA 8 megapixels
STORAGE 16GB
WIRELESS DATA None
SIZE 216x6.1x124mm
WEIGHT 305g
OPERATING SYSTEM Android 4.4.4
WARRANTY One year collect and return
DETAILS www.dell.com/uk
PART CODE Venue 8 7840



See page 72 for performance details

COMPACT SYSTEM CAMERA

OLYMPUS PEN E-PL7



£499 inc VAT • From www.jessops.com
(Price and rating based on 14-42mm EZ kit)

VERDICT

A consummate all-rounder, the E-PL7 scores particularly highly for speed and style

SIX YEARS AFTER the first Olympus PEN sparked a revolution in camera design, the fact that there are so many similar cameras today is a testament to how influential the concept has been. Even so, few other compact system cameras (CSCs) can match the E-PL7 for style. There's an air of sophisticated retro chic, and the sturdy metal shell and dials inspire confidence.

There's nothing retro about the specification. The touchscreen tilts up by 80° and down by 180°, popping out beneath the camera for selfie shots. A digital spirit level helps keep the camera straight, and you get face detection with eye priority. Continuous shooting is quoted at 8fps, or at 3.7fps with continuous autofocus. As with all Olympus CSCs, optical stabilisation is built into the sensor so it works with any lens.

PANCAKE DAY

A new kit lens, the EZ Pancake, has a motorised zoom function and collapses down to 22.5mm when it's powered off. With the help of a slim lens cap, the camera measures just 67mm front to back. We prefer a manual zoom mechanism as it's more responsive to adjust, but on balance this new lens is a definite improvement. It also adds £100 to the price. The E-PL7 is available with the older M.Zuiko Digital 14-42mm 1:3.5-5.6 II R lens for £399, compared to £499 with the EZ Pancake.

At 450g, the E-PL7 is heavier than the Sony a5100, Samsung NX3000 and Panasonic GF7. The E-PL7's detachable flash unit adds to the bulk, while the a5100 and GF7 have flash units built in. The flipside is that the E-PL7 can accommodate a more substantial flashgun or be used to trigger wireless flash systems.

The controls are highly customisable, with the ability to redefine most buttons, and to set the default function for the command dial in each of the four exposure modes. Manual focus is assisted by a focus peaking display that highlights sharp edges, plus a momentary

10x magnification. You can also customise the Auto ISO mode and offset white balance presets, but these functions could be easier to locate. Pressing OK reveals various functions on screen, but it's a shame they're spread over two pages. The touchscreen could have provided quicker access to the whole set.

Wi-Fi implementation is excellent. There's no NFC, but it's easy to establish a connection by pointing the Android or iOS device's camera at the QR code on the camera's screen.

Some cameras' remote shooting apps only cover basic settings such as shutter release, flash and self-timer. This one goes much further, with the ability to adjust the zoom, set the drive mode, exposure mode, white balance and exposure settings, as well as tag images with GPS metadata. Best of all is the ability to touch the screen to define the autofocus point; a crucial feature for portraits.

Setting the exposure mode to Manual unlocks Live Bulb mode, whereby the shutter stays open for as long as the app's button is held down (an alternative Live Time mode uses a tap to start, another to finish). The preview image in the app updates for the duration of the exposure, starting off dark and sharp and gradually superimposing additional layers of the image. It's a great way to experiment with bulb shooting.

SHOOTING STAR

Shooting performance is the E-PL7's greatest strength. Autofocus takes just 0.2 seconds, and being able to tap the screen to set the focus point helped enormously too. We timed 0.5 seconds between shots in normal use, both for JPEGs and Raw capture. Continuous shooting was at 7.4fps in our tests, slowing to 3.2fps after 37 frames. For Raw, it slowed to 2.2fps after 13 frames. Enabling continuous autofocus gave a 3.5fps shooting speed. These figures are among the best we've seen at this price, both from CSCs and SLRs.

Video isn't quite as impressive. Support for manual exposure and touchscreen-powered spot focus is welcome, but the fixed 30fps frame rate will deter keen videographers. So too will the slightly coarse details compared to 1080p footage from Panasonic G-series

cameras. Noise levels are impressively low at ISO 3200, though, and overall quality is more than up to scratch for casual use.

Olympus has been fitting its PEN and OM-D cameras with 16-megapixel sensors for three years. The E-PL7's image quality is in line with previous models, and also compares well with rivals. The lens performed superbly, with sharp focus into the corners of frames and little evidence of chromatic aberrations. It's impressive for such a slim zoom lens.

GLOSSING OVER THE FACT

JPEGs displayed punchy details, although comparing them to Raw files processed in Lightroom, there was a slight glossing over of the subtlest of details. We'd expect the best results from Raw files, though, so this is hardly a criticism. Similarly, Lightroom's noise reduction outperformed the camera's JPEG output, but the E-PL7 still managed to deliver print-quality JPEGs at ISO 3200. Low-res copies for online sharing look respectable all the way up to ISO 16,000 – a superb result.

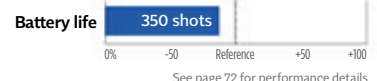
There's lots to praise about the E-PL7. It's not short of competition, though, and the price is over double that of the Samsung NX3000 (see *Reviews*, *Shopper* 323). However, the Olympus is faster, it's arguably better looking and the choice of lenses is greater, which is enough to keep it in the running.

Ben Pitt



SPECIFICATIONS

SENSOR RESOLUTION 16 megapixels
SENSOR SIZE 17.3x13mm
FOCAL LENGTH MULTIPLIER 2x
VIEWFINDER Optional VF-4 unit
LCD SCREEN 3in (1,037,000 dots)
OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3x (28-84mm)
35mm-EQUIVALENT APERTURE f/7-11.2
LENS MOUNT Micro Four Thirds
WEIGHT 450g
DIMENSIONS 69x127x67mm
WARRANTY One year RTB
DETAILS www.olympus.co.uk



PREMIUM COMPACT SYSTEM CAMERA

SAMSUNG NX1

COMPUTER SHOPPER



BEST BUY

£1,299 inc VAT • From www.wexphotographic.com

(Price and rating based on body-only package)

VERDICT

Fast, feature-packed and massively capable, the Samsung NX1 is an unbridled success

THE NX1 IS a significant step up from its predecessors. It's also significantly dearer, with a body-only price on a par with entry-level full-frame SLRs, but its specifications read like a wish list of advanced features.

The 28-megapixel sensor offers the highest resolution to date for an APS-C sized sensor, and includes 205 autofocus points for lightning-fast autofocus. The magnesium alloy body is weather sealed and covered with buttons and dials. Both the rear screen and electronic viewfinder (EVF) use OLED technology for deep contrast and excellent viewing angles, and their high resolutions mean they're pin sharp. The rear touchscreen tilts up and down, there's also a passive, backlit LCD screen for relaying settings, and it can shoot video at 4K resolutions.

We can always find something to moan about, though: there's no PC sync socket for triggering studio flashes. Battery life is also modest, and in-camera charging via the USB port means you can't shoot with one battery while charging another. Additional batteries cost £50 and an external charger is available for £25. An optional vertical grip (ED-VGNX01, £180) helps by housing an additional battery.

BIG IS BEAUTIFUL

The NX1 is a big camera. There are dual command dials plus a rear wheel for direct access to exposure settings. The wheel can be assigned to exposure compensation or ISO speed, among other options. There's a dedicated dial for drive mode, and four buttons for ISO speed, autofocus mode, metering mode and white balance. An AF On button means it's possible to assign autofocus

and shutter release to separate buttons, thereby only refocusing when necessary. With buttons for exposure compensation, DOF preview, AE Lock and various customisable buttons, there's nothing left to be desired.

A button on the back accesses Wi-Fi functions. NFC is built in, and the NX1 also includes Bluetooth, which establishes a constant connection between the camera and Android device. That means image transfers and the remote viewfinder mode can be launched directly from the app.

THE FAST SHOW

Continuous shooting at 15fps is the fastest sustained performance we've seen, and the fact that the NX1 delivers it with continuous autofocus is an incredible achievement. We measured 13.4fps with a $\frac{1}{1000}$ s shutter speed, slowing to 2.3fps after 60 JPEGs. Shooting with a $\frac{1}{5000}$ s shutter, it managed 15.2fps. Raw capture lasted for 20 frames before slowing to 2fps. Tracking accuracy is excellent.

The camera performs well in normal use, too, taking one second to switch on and capture a photo. Autofocus is responsive, but occasionally it was flummoxed by a scene and was unable to focus at all. Shot-to-shot times in Single drive mode were 0.6 seconds when using the viewfinder and 0.7 seconds when shooting with the screen. Full power flash shots were just 1.8 seconds apart.

4K recording suggests the NX1 is a serious video camera. There's Cinema 4K (4,096x2,160) at 24fps, plus UHD (3,840x2,160) at a choice of 24, 25 and 30fps frame rates. Selecting 1080p adds 50 and 60fps capture, plus 100fps and 120fps with slow motion playback. Recordings are up to 30 minutes, but only SDXC

cards. Videos are encoded in HEVC format, which keeps file sizes down, but at the expense of compatibility. None of the Windows editing software we tried could handle these files, and barely any playback software could either. It's a shame the NX1 doesn't have an AVC option.

4K footage saw blisteringly sharp details, even better than the fantastic Panasonic GH4. 1080p footage wasn't quite as



impressive, with digital sharpening giving a slightly pixelated appearance. The GH4 also took the lead for colour handling; the NX1 has various colour controls specifically for video but we weren't able to achieve the same extended dynamic range.

There's an impressive supporting cast of video features, including full priority and manual exposure control modes. We were able to set the shutter speed, aperture and exposure compensation and still leave the NX1 to adjust the overall exposure level using automatic ISO speed. The touchscreen and phase-detect points deliver responsive, highly controllable autofocus. The camera can stream a clean, uncompressed 4K output with timecode over HDMI. We'd have preferred a more substantial HDMI socket, though.

FINER DETAILS

The NX1 outperformed the GH4 in photo tests, with sharp and smooth details. It resolves sharper details than the 24-megapixel Nikon D7100 and D610, and is far ahead of rival CSCs.

Noise levels were broadly on a par with APS-C SLRs. It outperformed the Panasonic GH4 (which uses a smaller sensor) but didn't match the Fujifilm X-T1 or Sony a7. Fine details such as hair and foliage began to lose their definition in JPEGs as the ISO speed went up.

Everything about the NX1 impresses, and it's stuffed to the gills with superb features. It may fall behind the Fujifilm X-T1 for image quality in low light, and the Panasonic GH4 narrowly clings on to its crown as the best camera for video, but if you need one camera for both tasks, the NX1 is our top choice.

Ben Pitt



SPECIFICATIONS

SENSOR RESOLUTION 8 megapixels
SENSOR SIZE 23.5x15.7mm (APS-C)
FOCAL LENGTH MULTIPLIER 1.5x
VIEWFINDER Electronic (2,360,000 dots)
LCD SCREEN 3in (1,036,000 dots)
LENS MOUNT Samsung NX
WEIGHT 550g
DIMENSIONS 103x145x82mm
WARRANTY One year RTB
DETAILS www.samsung.com/uk



ULTRA HD MONITOR

ACER S277HK



£560 inc VAT • From www.pcworldbusiness.co.uk

VERDICT

The Acer S277HK is a stylish Ultra HD monitor with fabulous image quality, but it's not hugely practical

ACER'S STRIKING 27in S277HK Ultra HD monitor will divide opinion. Acer has shunned tradition and, more importantly, symmetry, by placing the monitor's stand on the right side of the base, creating a reverse L-shaped stand. The base itself is a wireframe divided into two asymmetrical sections, with the surface of the desk visible. It's distinctive, and creates a flat space in which to store desk toys or pens.

The frame itself is made from a light grey brushed metal similar to the material seen on Asus's cheap Switch tablets. It looks fine, but doesn't quite have the premium feel that the near-£600 price suggests. When the monitor is switched off, the bezels are only 1mm thick, which is astonishingly thin. However, as is the case with all super-svelte monitors, when the screen is on, you'll see an extra 8mm of black space around the left, right and top edges. It's still impressive, but we long for the day where these black bars are a thing of the past.

The stylish design means the S277HK isn't as practical as it could be. There's no height-adjustable stand, no swivel and no portrait mode. These are often expensive

represented onscreen, with detail bursting from the small nuanced shades of high-resolution photographs. We measured sRGB colour gamut coverage at 99.9%, which is almost perfect, while contrast was a fine 883:1. Black levels were decent at 0.27cd/m², but colour temperature was slightly off at 6858K, which results in slightly cooler colours than you'd expect from a screen calibrated to 6500K. Switching to the Graphics colour preset improved this to 6583K, and also improved contrast slightly to 911:1.

As a consumer-level monitor there are no promises of professional-grade accurate colours, but in our sRGB colour accuracy tests

The onscreen menus are fairly basic and not particularly easy to navigate, in part because the buttons aren't labelled on the front of the monitor, but also because the symbols representing forward, back, left and right are similar and can get confusing when you're navigating in and out of menus.

There are five preset colour modes from which to choose: Standard, ECO, Movie, Graphics and User, which lets you adjust colour balance, temperature and gamma. You can also switch on a 'super sharpness' mode that makes text sharper, but gives everything else an unpleasant black border, which we wouldn't recommend. A picture-in-picture mode allows you to view two inputs on screen at once. Finally, there's an sRGB mode that increases colour accuracy even further, giving us an average Delta E score of 1.07.

The Acer S277HK is an attractive monitor with excellent image quality. If you don't need an adjustable stand or USB ports, it's a great buy and one of the best-performing 4K monitors for under £1,000 we've reviewed to date. However, if you're after something slightly more practical, the Asus PB279Q (see *Shopper 326*) has equally good colour accuracy, a USB hub and an adjustable stand, and only costs around £40 more.

Michael Passingham

Images with vibrant colours are faithfully represented onscreen, with detail bursting from high-resolution photos

extras, though, so whether this is a problem for you will depend on how you work.

The rear of the monitor is coated in a shiny white plastic we think looks a bit cheap. The DVI, HDMI, Mini DisplayPort and DisplayPort video inputs are on the rear facing backwards instead of the conventional downwards, and about halfway up the back of the panel. This means things will look untidy if you have your monitor facing away from clients.

CLUTTER BUG

An external power brick is used instead of an internal one, which may increase desk clutter further. There's no USB hub either, so you won't be able to reduce wires trailing across your desk by plugging peripherals into the monitor. However, stylish monitors rarely add this practical feature.

The S277HK's 27in IPS panel has a 3,840x2,160 resolution. At this price you should be expecting wide colour gamut coverage to get the most out of high quality Ultra HD images and video, and it delivers just that. Images with vibrant colours are faithfully

the S277HK managed some truly outstanding scores. We measured the average Delta E (where a lower score is better) at 1.4, which is up there with more expensive professional panels. The panel's weakest colour is red, which is slightly oversaturated, but all other colours are well served by the S277HK.

NOT THE FULL GAMUT

Adobe RGB, which is the colour gamut used by professionals working in print, isn't so impressive. Coverage of 72% won't be good enough for design professionals, but then this monitor isn't marketed at them. Home and office users, though, will be just fine.

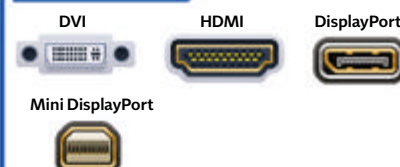
Backlight uniformity is reasonable: the outer reaches of the panel are 10% darker than the middle, but in normal conditions this won't be noticeable. Viewing angles are also wide, with minimal contrast and a slight blue tinge when the panel is viewed from oblique angles. Gamers should be well served by a low 10.3ms input lag time, making the S277HK a great choice if your PC is powerful enough to output games at Ultra HD resolutions.



SPECIFICATIONS

SCREEN SIZE 27in
RESOLUTION 3,840x2,160
SCREEN TECHNOLOGY IPS
REFRESH RATE 60Hz
VIDEO INPUTS DVI, HDMI, DisplayPort, Mini DisplayPort
WARRANTY Two years onsite
DETAILS www.acer.co.uk

CONNECTION PORTS



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- 3 Customized user settings
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computers

PROFESSIONAL ULTRA HD MONITOR

SAMSUNG U32D970Q



£1,369 inc VAT • From www.ballicom.co.uk

VERDICT

Supreme colour accuracy, but the U32D970Q's imperfections are less forgivable at this price

ONCE YOU GET near the top end of any product line, the smaller the gains are for each pound you spend. Samsung's U32D970Q is a perfect example: at nearly £1,400 it has some truly outstanding features but also some odd quirks that some users might find frustrating.

The 31.5in, Ultra HD 3,840x2,160 PLS (similar to IPS) panel is developed in-house at Samsung and is currently available only in this monitor. Its specifications include 100% sRGB coverage, 99.5% Adobe RGB coverage and 1,000:1 contrast levels. Each monitor is calibrated before it's shipped, and comes with its own unique calibration report. The factory calibration is the default colour profile when the monitor is switched on, so we tested it to see how well calibration had been conducted.

True to its claims, sRGB coverage was a perfect 100%, while Adobe RGB was at 99.7%, better than the claimed 99.5%. We were a little bemused by the low contrast score of 343:1, and also disappointed by high black levels of 0.7cd/m² that left some blacks looking a shade lighter than we'd expected.

A perfectly executed picture-in-picture mode lets you display up to four different inputs onscreen at once

The main advantage of this profile is that it prioritises accurate colours above all else. In our calibration tests, where a lower figure is better, it scored a superb average Delta E of 1.15, which is one of the lowest scores we've seen. It means you can trust the colours displayed to the extent that the human eye won't be able to tell the difference between the 'perfect' colour and the colour onscreen.

STANDARD PRACTICE

The other modes were unable to demonstrate such accuracy, although their purposes are more for specialist applications. Profiles are included for industry standards such as DICOM for medical imaging, EBU for European broadcasting and SMPTE-C for TV in the US. There's also a high-brightness setting that boosts the monitor's backlight from 227cd/m² to over 300cd/m², which is probably too bright for most users sitting less than a couple of feet away from the screen.

We were slightly frustrated by the U32D970Q's inflexibility: we liked the colour

balance and accuracy that the factory calibration provided, but we wanted to be able to adjust it further to boost contrast and brightness, which some of the other profiles were able to do. You can't copy a profile to a custom setting, and there's no way of knowing what the colour settings of the factory profile are, so you can't copy them. What's more, there's only one custom profile available, so you can't make more than one.

BACK CHAT

Backlight uniformity is superb. The darkest portion of the screen compared to the centre is the top-right corner, which we found to be 10% darker when the monitor was set to maximum brightness. In everyday usage you're unlikely to notice this, and this performance is substantially better than many



quite sit straight and can easily be rotated slightly to the left. You can rotate it 90° in the other direction to work in portrait mode, but we're at a loss as to why we were able to rotate it in the wrong direction. If you'd rather attach it to your own

equipment, Samsung provides a VESA mounting plate. There's no hood, though.

On the back of the U32D970Q are two USB3 ports. Instead of facing sideways, they face backwards, which makes them difficult to reach. There are two more USB3 ports facing downwards, sitting alongside the 3.5mm audio output, DVI, HDMI, and two DisplayPort connectors. You'll want to use the monitor at a refresh rate of 60Hz rather than 30Hz, so your primary devices should be connected via DisplayPort, not HDMI or DVI; these ports can only support Ultra HD resolutions at 30Hz.

NOBODY'S PERFECT

The U32D970Q's superb 32in Ultra HD panel delivers incredibly accurate colours. However, imperfections with the way it handles custom colour profiles and the odd build quality issue mean it doesn't reach the high standards we'd expect from Samsung and, more importantly, the huge price. If you're not in the market for something quite so extreme, Asus's PB279Q (see *Shopper 326*) is a stunning, albeit smaller, Ultra HD monitor for less than half the price. If you're only after a 32in screen and need Ultra HD, the Samsung S32D850T (see *Shopper 323*) has a 32in panel with a still impressive 2,560x1,440-pixel resolution.

Michael Passingham

SPECIFICATIONS

SCREEN SIZE 32in
RESOLUTION 3,840x2,160
SCREEN TECHNOLOGY PLS
REFRESH RATE 60Hz
VIDEO INPUTS DVI, 2x DisplayPort, HDMI
WARRANTY Two years collect and return
DETAILS www.samsung.com/uk

CONNECTION PORTS





FROM THE DIRECTOR OF THE DARK KNIGHT TRILOGY AND INCEPTION

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4K LCD TV

PANASONIC

Viera TX-55AX902B

COMPUTER SHOPPER ★★★★★

RECOMMENDED £1,999 inc VAT •

From www.johnlewis.com

VERDICT

Fantastic image quality and unbeatable LCD black levels. One of the best 4K TVs yet

WHEN PANASONIC LAUNCHED

its TX-50AX802 4K TV last year it came without support for 4K Netflix, which is still one of the only ways of watching anything in 4K. Buyers had to wait almost six months before a firmware update added it. Thankfully, the AX902 doesn't repeat its predecessor's missteps, as it comes with 4K Netflix and Amazon Instant Video support. It also retains the AX802's elegant yet rather monolithic design, weighing a massive 26kg – and that's not including the huge 14kg stand.

The AX902 produces a stunning picture. Its direct LED backlight and full-array local dimming produce deeper blacks, better contrast and a more uniform picture than an edge-lit panel. It does this by analysing the video input across 128 local dimming zones and using a 5x5 matrix system instead of the usual 3x3 to fine-tune the brightness level on the fly, significantly reducing unwanted halo effects around brighter objects.

STARS IN THEIR EYES

It certainly made a big impact on our Blu-ray test footage, with distant stars looking pin sharp during *Star Trek*'s fast camera pans, and we didn't see any patches of light creep in during darker scenes. Likewise, black levels were easily the best we've seen from any LCD TV in recent months, and we were repeatedly amazed that we weren't looking at an OLED panel. Admittedly, our post-calibration reading of 0.25cd/m² would beg to differ, but to our eyes, the AX902's black levels are about as deep as they get for an LCD.

Contrast was also impressive, and enabling the Contrast Control settings in the advanced menu made a huge difference to the level of detail visible onscreen. The Auto setting gave dark areas of shadow a significant boost, but you can also customise the setting yourself using the

➔ The AX902 comes with two remotes, but we found the Smart remote touchpad fiddly to use



adaptive gamma control, black expander and clear white effect options. Panasonic's adaptive backlight control and ambient light sensor also do a great job of adjusting the panel's brightness to suit your surroundings, so you won't have to sit in total darkness to get the best picture.

Testing the Normal picture mode at its default settings, our colour calibrator measured just 77.3% of the sRGB colour gamut. Once we'd changed the picture mode to Professional 1, changed the colour temperature to Normal and tweaked the white balance settings, we achieved a much more respectable 98.4%, putting this TV right up there with last year's AX802.

Admittedly, Panasonic's menu settings could be easier to use, as its huge list of options can be unwieldy. Still, you're spoiled for choice, with eight picture modes, basic backlight, brightness, contrast, colour, tint, sharpness and colour temperature options and several more advanced settings. These include colour gamut options, gamma controls and a full colour management system that lets you control the hue, saturation and luminance for RGB and CMY.

Our 4K demo clips looked stunning on the AX902, but it also upscaled 1080p content extremely effectively. Blu-rays looked surprisingly sharp, but we'd recommend leaving the 1080p Fire Direct and 1080p Pixel by 4pixels options off as they made everything look jagged and pixellated, particularly if there was any text onscreen.

RANGE ON THE HOME

We were pleased to see that the My Home Screen UI has received a few essential updates. When you turn the TV on, it presents the Freetime home screen, with a large window showing your current source and shortcuts to Freetime's TV guide, on-demand channels, a search bar and Showcase, which collects all the best TV from the week in one handy location.

Previously, you could only use Freetime if you had Freesat installed, but nearly all of Panasonic's new TVs come with it built in, giving



you the full range of British TV catch-up services without the need for a satellite dish or set-top box. This includes BBC iPlayer, ITV Player, 4oD and Demand 5, and they're presented in Freetime's familiar scrolling TV guide interface.

Netflix and Amazon Instant Video are found in the apps menu (which you can access quickly using a shortcut on the remote) as well as YouTube, Crunchyroll and Wuaki.tv. This selection compares well with those from other TV manufacturers, although Samsung still has the widest range of smart TV services while LG has built-in Now TV.

At the back, you'll find an excellent range of ports, including four HDMI 2.0 inputs that are HDCP 2.2 compatible, one DisplayPort, an adaptor for SCART and component inputs, a CI slot, an SDXC card reader, an optical S/PDIF output, three USB ports (one of which is USB3) and a headphone jack. There's also an Ethernet port, but you shouldn't need it with built-in wireless on board.

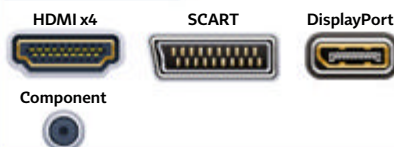
Panasonic's AX802 was a fantastic TV once 4K Netflix arrived, but the TX-55AX902B betters it in almost every way. It has incredible black levels, fantastic image quality and excellent contrast controls. It's also cheaper than LG's Full HD 55EC930V OLED, making the AX902 an attractive choice for anyone who doesn't want to wait for 4K OLED. With its superb upscaling and outstanding image quality, the AX902 is our new favourite 4K TV.

Katharine Byrne

SPECIFICATIONS

SCREEN SIZE 55in
NATIVE RESOLUTION 3,840x2,160
VIDEO INPUTS 4x HDMI, 1x DisplayPort, SCART, component, SDXC card reader
TUNER Freesat HD, Freesat HD
DIMENSIONS 741x1,238x283mm
WARRANTY Five years RTB
DETAILS www.panasonic.com
PART CODE TX-55AX902B

CONNECTION PORTS



4K-READY AV AMPLIFIER

ONKYO TX-NR636

COMPUTER SHOPPER

★★★★★

RECOMMENDED £450 inc VAT •

From www.audiovisualonline.co.uk

VERDICT

A fantastic AV receiver with 4K-ready ports and support for Dolby's Atmos 3D sound

ONKYO'S NEW MID-RANGE TX-NR636 is about as futureproof as AV receivers get. For starters, it's one of the only current AV receivers to support Atmos, Dolby's three-dimensional surround sound technology, which has gradually made its way into commercial cinemas over the past three years. You don't need a whopping 128 individual speakers to get a similar effect in your living room, either – Atmos Home can deliver a similar level of accuracy through a much smaller surround-sound system.

Those who don't want to replace their entire sound system can place Atmos up-firing Elevation speakers on top of their current front and rear speakers to reflect any overhead sounds off the ceiling. We tested with a pair of Onkyo SKH-410 speakers, which you'll have to buy separately (£129 from www.audiovisualonline.co.uk), but at least they save you having to install anything in your ceiling.

The TX-NR636 requires a firmware update to add Atmos support, which takes around 20 minutes. You'll also need a Blu-ray player that can decode Dolby TrueHD audio over bitstream. Sadly, this ruled out our original PlayStation 3 console, but we had no problem using a PS3 Slim once we'd set the audio settings to bitstream in the Blu-ray audio menu.

We tested Atmos with a selection of clips from a reference demo disc and *Transformers: Age of Extinction*, the first film to include an Atmos soundtrack. The effect was subtle, but sounds such as rain and splintering glass were certainly coming from above rather than the sides, adding a sense of height to the soundscape.

However, the jump in quality wasn't as impressive as moving from a stereo setup to surround sound, and we're not entirely convinced that

adding two up-firing Atmos speakers adds much to the overall sense of audio immersion. Still, the TX-NR636 certainly made our audio sound fantastic, so you won't be disappointed even if you're don't buy into Atmos.

The TX-NR636 is bursting with ports. Five of its seven HDMI outputs support HDMI 2.0 (including the one on the front), so you'll be able to play 4K video at a full 60Hz. One port also supports HDCP 2.2, so you'll have to use this one when 4K streaming on Netflix and Amazon Instant Video finally arrives on platforms other than smart TVs.

The two HDMI 2.0 outputs are handy for connecting two displays, as you won't have to switch cables when swapping between a TV and projector. Again, only the main output supports HDCP 2.2, so you'll only be able to have one display running HDCP 2.2-protected 4K content at a time, but it's still great to see this feature on a mid-range receiver. The main output also supports an audio return channel (ARC), so you can output your TV's sound to your surround-sound system as well.

OLD SOUNDS

There's support for older equipment too, including three composite inputs, a composite output and component in and out. These connections are becoming increasingly redundant now that so many devices support HDMI, but removing them wouldn't help reduce the size of the unit anyway.

The Onkyo's chassis may be massive but at least it provides plenty of services. As well as AM and FM radio antenna connections and an Ethernet port for streaming music from a PC or NAS over DLNA, it comes with Spotify, TuneIn, Aupeo! and Deezer built in. With integrated wireless internet and Bluetooth, the Ethernet port is unlikely to get much use. The only major oversight is the lack of AirPlay, which will disappoint Apple owners.

Audio inputs are plentiful. With binding posts for seven satellite speakers and two subwoofer pre-outputs, you can run a 7.2 surround sound setup if you have the space. The TX-NR636's Zone 2 input terminal also has binding posts, so you can even power a pair of stereo speakers in another room.

A useful selection of front-facing inputs complements the bevy of connections at the back, including a 6.3mm headphone jack, a USB port for playing MP3, FLAC, AAC, Apple Lossless and WMA Lossless files from a flash drive, a 3.5mm calibration microphone and an MHL-compatible HDMI input, which lets you watch Full HD videos from compatible mobile devices on your TV. The latter was located on the back of the older TX-NR626, so its new location on the front makes connecting a compatible smartphone or tablet a lot easier.

The TX-NR636 is easy to set up thanks to its bundled Onkyo AccuEQ microphone, which automatically calibrates the levels and distance of each speaker. The functional menus are easy to navigate, and while the TX-NR636 still doesn't have the slickest interface when compared with a modern smart TV, it's still better than those of most other amplifiers we've seen.

SPONGE FINGERS

The remote isn't a strong point, with spongy buttons that don't give much tactile feedback and a slow interface that can make scrolling through menus a bit of a chore. The IR receiver doesn't work well from the side either, so you'll need to point it directly at the receiver to get the best response.

Remote control issues aside, the Onkyo TX-NR636 will almost certainly satisfy anyone who wants a futureproof AV receiver. While the appeal of Atmos will depend on your dedication to getting the most immersive sound experience possible, the multitude of 4K-compatible ports should be more than enough to satisfy even the most device-hungry users.

Katharine Byrne



SPECIFICATIONS

HDMI INPUTS/OUTPUTS TOTAL 7/2
HDMI 2 INPUTS/OUTPUTS TOTAL 5/1
OUTPUT RESOLUTIONS 720p, 1080p, 4K
WIRELESS SUPPORT 802.11n, Bluetooth 2.1
SPEAKER CONFIGURATION 7.2
RMS POWER OUTPUT TOTAL 1,120W
SIZE 435x173x329mm
WARRANTY Two years RTB
DETAILS www.uk.onkyo.com
PART CODE TX-NR636

CURVED 4K TV

SAMSUNG UE65JS9000



£3,999 inc VAT • From www.currys.co.uk

VERDICT

The JS9000's picture quality is gorgeous and we're big fans of the new Tizen UI, but it's expensive and viewing angles aren't brilliant

4K IS UNDOUBTEDLY a major upgrade over Full HD, but Samsung wants its new premium TVs to stand out even more – so much so that it has created a dedicated sub-brand. The JS9000 is the first SUHD TV we've seen, and although we're not convinced the 'S' in SUHD really stands for anything special, the JS9000 offers some impressive headline features.

Chief among these is support for high dynamic range, or HDR, which uses a more powerful backlight to open up a wider colour palette and produce brighter, more vivid images with greater contrast levels. Sunlight glinting off the ocean in *Life of Pi* looked incredibly natural, illuminating the scene with impressive peak brightness. The effect was even more prominent on the gold chainmail armour on the Pharaoh's guards in *Exodus: Gods and Kings*. There's only a limited amount of HDR content available so far, as the standard has yet to be finalised, but at least your TV will be ready for when it arrives.

The JS9000's curved quantum-dot panel uses nanocrystal semiconductors to emit different colours based on their size. By placing a film of these dots in front of the LCD backlight, the TV can produce brighter, more vibrant colours – Samsung claims it should be twice as bright as a traditional LCD.

This was confirmed in our tests. We measured a peak brightness of 318.05cd/m² in Standard picture mode, while Dynamic mode reached almost 490cd/m². You can adjust this with the backlight controls, but you certainly won't be lacking a bright, punchy picture.

IN THE PINK

We felt that whites had a pinkish tint in Normal mode at the default settings, but otherwise we were impressed by its overall colour accuracy. Our colour calibrator returned an sRGB colour gamut score of 97.1%, with blacks measuring a pleasingly deep 0.08cd/m². Contrast was also high at 3,827:1, giving images plenty of detail.

We switched to Cinema mode for the rest of our tests, increasing the Backlight to 19 to

match Normal's brightness levels. We then went into the 10-point white balance settings in the advanced menu and set the interval to 90%, altering red to +16, green to +2 and blue to -22. This balanced out the JS9000's white levels considerably, increasing the overall colour accuracy to an outstanding 99.6%. Blacks sadly slipped to 0.11cd/m² and contrast to 2,950:1, but it was difficult to spot by eye.

Dark scenes in *Star Trek* were still full of detail, and the depths of space looked black and inky – at least when we viewed the TV face on. Shifting to the side a little revealed a few lighter areas near the edges, and colours lost some of their vibrancy. This obviously isn't ideal on such an expensive TV, and it hardly makes a compelling case for having a curved screen when cheaper, flatter 4K TVs such as the Panasonic TX-55AX902B offer such superior viewing angles.

You'll also want to watch HD TV channels whenever possible, as the JS9000's upscaling is disappointing. Standard-definition TV was blocky and soft, even with the MPEG Noise Filter and Digital Clean View options set to High. This greatly improved when we switched to HD channels, however.

The JS9000 comes with a revised Smart remote as well as a regular remote. Like previous designs, it has an accelerometer, and pointing at the TV to bring up a small cursor that follows your movements around the screen. This makes navigation much faster than using conventional buttons, and we like the textured grip and comfortable finger grooves on the back. It has fewer buttons than the standard remote, but all the essentials are there.

The new Tizen-powered UI is a huge improvement over last year's interface. Text is much cleaner and icons look more modern, so the whole interface feels slicker, yet refreshingly unintrusive. A long row of colourful icons appears along the bottom of the screen, so you can carry on watching while you decide what to do.



Smart Hub is similar to LG's webOS interface, with recent apps and channels running along the bottom of the screen. You can pin apps to your recent list so they're easier to find. A small square of featured apps to the left switches with the app list to reveal recently added apps, games, the JS9000's web browser and shortcuts to any connected devices, such as your phone, tablet or PC.

When we tested the JS9000, it was missing Netflix, 4oD and Demand 5, but Samsung assured us these will be available soon via a firmware update. Instead, you'll find Amazon Instant Video, BBC iPlayer, ITV Player, YouTube and Plex. There are also apps for Skype, BBC News and BBC Sport.

WHAT'S ON THE BOX?

Samsung's One Connect box means only two cables plug into the TV itself. The box offers a healthy selection of connections, including four 4K-ready HDMI ports, and can be upgraded in the future, so you won't be left behind if new HDMI and HDCP standards are introduced.

At £3,999, the JS9000 is expensive. We like the new Tizen UI, but when Panasonic's AX902 is available for £1,999 and offers better viewing angles and an equally great-looking picture, the JS9000 doesn't do quite enough to justify the extra price.

Katharine Byrne

↓ Samsung's new curved Smart remote has a built-in accelerometer for quick navigation



SPECIFICATIONS

SCREEN SIZE 65in
NATIVE RESOLUTION 3,840x2,160
VIDEO INPUTS 4x HDMI, component, composite
TUNER Freeview HD, Freesat HD
DIMENSIONS 916x1,465x366mm
WARRANTY One year RTB
DETAILS www.samsung.com/uk
PART CODE UE65JS9000

CONNECTION PORTS



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RECOMMENDED



£60 inc VAT • From www.currys.co.uk

VERDICT

A sleek design and decent sound for a speaker of its size and price

THE PURE VOCA has a contoured metallic body that feels heavier than you might expect for its size. A small rubber platform on the bottom helps prevent scratches and absorbs some of the chassis reverberation, which is a welcome addition. The dark silver brushed-metal finish looks slightly purple under certain lighting, but it's classy, with a large speaker grille on the front and a subtle Pure logo in the corner.

All the controls are easy to access on the top of the unit, with rubberised buttons that

contrast with the metallic body. The power and Bluetooth buttons are backlit to make them easy to find in the dark.

A 3.5mm auxiliary input on the back lets you connect devices that lack Bluetooth. There's also a DC charging jack, but we'd have preferred it if the Voca charged over Micro USB, as that would mean carrying one less charger. There's no NFC pairing either, although we had no trouble pairing the Voca with a Bluetooth device.

The built-in battery provided around 10 hours of continuous music playback, which is slightly above average for a speaker of this size. Some form of battery life indicator beyond the beep that indicates you've reached a critically low percentage would have been useful though.

Two full-range 1½in speaker drivers are paired with dual passive radiators inside the Voca, which help produce a surprising amount of bass – so much so that you can feel the chassis reverberate during bass-heavy tracks.

The rubber feet provide some dampening, and thankfully the chassis doesn't rattle under the force, so we didn't detect any distortion.

The overall sound was surprisingly rich and well-rounded, with good representation across the full sound spectrum. You'll want to be relatively straight on to the speakers, though, as it begins to drop off slightly as you move away from the sweet spot. Our acoustic test tracks sounded pleasantly warm, making jazz in particular a pleasure to listen to. Its maximum volume was enough to fill a medium-sized room without creating too much distortion, although for comfortable listening, two-thirds volume is plenty.

If you're not looking to spend a lot on a Bluetooth speaker, the Pure Voca sounds great and looks good for the money. If you can stretch to it, however, we still prefer the similar-looking Cambridge Audio G2, which has the edge over the Voca both for sound quality and presentation.

Richard Easton

SPECIFICATIONS

SPEAKERS 2

RMS POWER OUTPUT 10W

DOCK CONNECTOR None

WIRELESS Bluetooth (SBC)

DIMENSIONS 189x55x67mm

WEIGHT 0.6kg

WARRANTY Three years RTB

DETAILS www.pure.com

PART CODE V440BT

RUGGED BLUETOOTH SPEAKER

DIVOOM Voombox Ongo



£57 inc VAT • From www.amazon.co.uk

VERDICT

Portable and rugged, but lacking in volume

DIVOOM'S VOOMBOX OUTDOOR (see *Reviews, Shopper 320*) impressed us with its massive sound for the size. The Voombox Ongo can be considered its smaller sibling, but, disappointingly, it's not quite as loud. This is a shame as it comes with a bike handlebar mount and tripod for taking it on the move. Sadly, it's not quite loud enough to hear over the exertion of cycling or the movement of the wind if you're pedalling at even a moderate speed, which negates its usefulness.

The Ongo's design is similar to the Outdoor's, with the same rubberised exterior and choice of bright colours. It's available in red, green, blue and orange, plus a more subdued black. Every model has a black bezel around the speaker grille with exposed screws that give the speaker a slightly industrial feel. A loop is built into one end, so you can easily clip it to a rucksack. The rubber finish is thick enough to absorb light impacts, but we wouldn't recommend throwing it around. It's also rated IPX44 water resistant, so it will survive being splashed but not submerged.

We were pleased to see a Micro USB port for charging, which means your smartphone charger can perform double duties. You'll get around eight hours of battery life off a single charge – exactly what we'd expect from a speaker of this size.

A 3.5mm auxiliary input and the Micro USB port are hidden behind a rubberised flap on the side, while volume, power and a

play/pause button are on the top. You can also use this button to answer incoming phone calls using the built-in mic, but it's not very sensitive so you'll need to be pretty close to the speaker if you don't want to shout.

The Ongo supports Bluetooth 4.0 but not the less lossy aptX codec. This isn't something we'd expect at this price, and is barely necessary given the meagre 7W power output from the two full-range 1½in speaker drivers. In contrast, the Voombox Outdoor could pump out a combined 15W. Even with a passive radiator on the back of the speaker, sound quality was only respectable. It wasn't quite as tinny as the Outdoor, with more presence in the lower frequencies, but certainly not enough to blow us away.

The Ongo couldn't reach the volumes necessary for outdoor use, making the Voombox Outdoor the better choice, even if you can't strap it to your handlebars.

Richard Easton

SPECIFICATIONS

SPEAKERS 2

RMS POWER OUTPUT 7W

DOCK CONNECTOR None

WIRELESS Bluetooth (SBC)

DIMENSIONS 140x60x73mm

WEIGHT 406g

WARRANTY One year RTB

DETAILS www.divoom.com

PART CODE Voombox Ongo



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SPOTIFY CONNECT MULTIROOM SPEAKER

PHILIPS Spotify Connect SW750M



£124 inc VAT • From www.amazon.co.uk

VERDICT

A reasonably priced multiroom speaker, as long as you're a Spotify Premium subscriber

MOST MANUFACTURERS OF multiroom speakers try to support as many streaming services as possible, even releasing updates to add new services as they appear. However, even as the streaming music landscape becomes more competitive, one service still stands well ahead of all others: Spotify.

It's so popular that Philips has partnered with Spotify for its first multiroom speaker system, eschewing all other services for an exclusive deal. That means that unless you have a Spotify Premium subscription, which provides access to Spotify Connect for streaming to wireless speakers, the SW750M will be nothing more than a large paperweight.

WELL CONNECTED

As Spotify Connect is a multiroom platform, you can add as many SW750M units to your home network as you can afford, and place them anywhere with a Wi-Fi connection. The Philips SpeakerSet Multiroom Manager app, available for iOS and Android, is the easiest way to connect extra speakers; an alternative browser-based setup forces you to connect to each speaker directly via Wi-Fi Direct in order to input your home network's details. The process is at least straightforward, with a setup wizard taking you through the process.

The app is also used for grouping speakers together and assigning different names, to help you identify which speaker to use. That's about as useful as the app gets, though. Music playback is controlled entirely through the Spotify app using the Spotify Connect interface for selecting speakers. Once more than one set of speakers is grouped, they will essentially function as one speaker appearing as a group in the Spotify app. This is a bit frustrating if you later decide you only want

to use one speaker; you'll need to go back into the Philips app to ungroup them before jumping back into Spotify. It would have been good if speakers could be grouped but still function independently as well.

PLAIN SPEAKING

The SW750M isn't much to look at, either. It has a plain design, with a large black face covered by a black speaker grille. Viewed from above it has an elliptical shape with silver accents, and the speaker angles backwards to diffuse sound around the room. It doesn't have anywhere near the same wow factor as multiroom speakers from the likes of Sonos.

side. If we were being picky we'd have liked more crispness and detail in the mid-tones and treble, as we found our Menahan Street Band test tracks lost some of their delicateness.

There is also a distinct directionality to the sound output. You'll want to be straight on to the speakers to enjoy the best sound quality. Move to the sides and the sound becomes thinner. At least there's no drop-off in quality.

The speakers reach a maximum volume more than loud enough to fill a medium to large-sized room, although it becomes muddy at the maximum level. The volume controls in Spotify aren't particularly linear, either. The speakers suddenly gain a lot of volume rapidly

Unless you have a Spotify Premium subscription, the SW750M will be nothing more than a large paperweight

Basic controls on the top include volume, track skipping and a play/pause button. One useful feature is the 'one-press' function that resumes the last song you played on Spotify just by hitting play. This is independent of the device on which you last used Spotify, so you could be listening on a smartphone or tablet, and pressing Play will resume where you left off. If you listen to Spotify on your commute home, you could instantly switch to the speakers once you get in. It's a small touch but we found it incredibly convenient.

This also means you don't need to have a device within reach if you just want to put some music on. There's no display, though, so you'll need to queue up a playlist beforehand. It also means there's no way to change albums or playlists from the speaker itself.

The SW750M uses four speaker drivers, which output a combined 20W. There are two 3in woofers with rear bass reflex ports, paired with two 35mm tweeters. A strong but not unpleasant bass presence pushes the overall sound signature towards the warmer

from around 95% upwards. Overall, sound quality is more than respectable for a £124 wireless speaker, but nothing groundbreaking.

If you're a Spotify subscriber and it's your main music service, Philips' SW750M makes a lot of sense. Each speaker rivals the sound quality of mid-range models from other manufacturers, but at an entry-level price. They have a nice level of simplicity, especially with the one-press functionality for quickly playing music. However, there's no 3.5mm auxiliary connection or Bluetooth, either of which would have made these a far more versatile set of speakers. If you're in need of greater versatility, consider the Samsung M3, which has more streaming service compatibility and better connectivity options.

Richard Easton

SPECIFICATIONS

SPEAKERS 4
RMS POWER OUTPUT 20W
DOCK CONNECTOR None
NETWORKING Wi-Fi
DIMENSIONS 360x135x210mm
WEIGHT 2.8kg
STREAMING FORMAT Spotify Connect
WARRANTY Two years RTB
DETAILS www.philips.co.uk
PART CODE SW750M/05



NZXT Doko



£99 inc VAT • From www.scan.co.uk

VERDICT

The NZXT Doko provides remote access to your PC, but its execution is poor for gaming

THE LIVING ROOM IS unquestionably the focus when it comes to gaming right now, even for PC manufacturers. Playing games and watching films is infinitely more comfortable from the sofa than stooped over a desk, but this doesn't necessarily mean building a small PC that will fit in your living-room AV cabinet.

Instead, you access content remotely from your main computer, via services such as Steam In-Home Streaming for gaming and devices such as Google's Chromecast or media streamers from Roku for your movies. These provide access to only a subset of your PC's gaming or media playback capabilities, though.

The NZXT Doko looks to provide access to your PC from anywhere in the home, emulating the experience you would get if you were sat in front of your PC – meaning the entire desktop and every available application.

OUT OF SIGHT

The device itself is no larger than an Amazon Fire TV box, which means it isn't very large at all. You could easily hide it out of view behind a TV or in a cabinet if you use a wireless keyboard and mouse. The matt black box has subtle branding embossed on the top but is otherwise plain, aside from a small LED integrated into the power button that glows white when the device is turned on.

Four USB ports on the front allow you to plug in compatible devices, which includes most plug-and-play keyboards and mice, USB storage devices and certain game controllers, which is supposed to include wired and wireless Xbox 360 controllers. An HDMI port on the back will let you hook up the box to a television or display, and an Ethernet port will get you connected to your home network.

The Doko works only over a wired connection, and NZXT recommends a Gigabit connection to your router for optimal network performance, but you could use a Powerline networking adaptor. Performance may suffer as a result, though. An Ethernet cable is included but you'll need to supply your own HDMI cable.

Another caveat is that the Doko will only support 1080p televisions. NZXT states that

lower-resolution displays might work, but you may experience reduced video quality and scaling issues. We tried connecting to a 720p television and were unable to get an image displayed at all.

To get the Doko working with your main PC, you'll need to install Doko's software first. It's not provided on a disc or flash drive so you'll need to download it from the Doko website. The software not only mirrors your computer's display but it also emulates a virtual USB hub so your computer can detect devices that are plugged into the Doko.

DRIVER HARD BARGAIN

We had no problems connecting a keyboard and mouse and using them to control the host PC. However, connecting an Xbox 360 wireless controller was less consistent. The controller would occasionally stop working and only a reboot of the Doko would rectify the issue. On contacting NZXT, we discovered that the drivers for the Xbox 360 controller requires administrator rights, meaning you need to run the application you want to use, such as Steam, in admin mode.

We had problems trying to play games remotely when the Doko was connected wirelessly to our router, with constant dropped frames and a lot of input lag

Similarly, we encountered problems trying to play Steam games when not in admin mode. Booting up any game would result in a black screen through the Doko but the game running on the host system. Running Steam in admin mode meant games worked fine. Another annoyance was that pop-up dialogs, such as Windows' User Account Control, didn't appear on the Doko's output, so we had to go to the host computer to clear them.

While the Doko is able to stream your PC's display at 1080p resolution it's also limited to 30fps, which is fine for most movie watching

or desktop use, but it's a slightly disappointing limitation for gaming.

Anyone more familiar with console gaming, where 60fps is typically more of a bonus than an expectation, might not be too dissuaded, but it's a letdown for dedicated PC gamers.

We also had problems trying to play games remotely when the Doko was connected wirelessly to our router. There were constant dropped frames and a lot of input lag, making even basic navigation in first-person titles such as BioShock Infinite frustrating.

PLUGGED IN

With our host system connected through a wired Ethernet connection performance was considerably better. There was still some minor input lag but it was no worse than we've experienced through other services such as Steam In-Home Streaming or Nvidia GameStream. The movie-watching experience was at least acceptable for the most part and we didn't notice any strong image

compression or artefacts while watching videos stored on our host computer.

The NZXT Doko is a great idea but its execution leaves a lot to be desired. The experience as it stands is far from seamless unless you only plan on using the device to access your desktop remotely. The movie-watching experience doesn't rival the performance and simplicity of a dedicated device such as Google Chromecast, Apple TV or a Roku media streamer. Extending remote gaming beyond Steam In-Home Streaming or requiring an Nvidia graphics card could have been the feather in the Doko's cap, but the mediocre implementation left us disappointed.

Richard Easton



SPECIFICATIONS

WARRANTY One year RTB

DETAILS www.nzxt.com

PART CODE AC-DOKOM-K1

SMALL OFFICE MFP

CANON Maxify MB5050



£162 inc VAT • From www.printerland.co.uk

VERDICT

A capable mid-range MFP for a small office, but it's not class-leading

CANON CALLS THE Maxify MB5050 a small office device. At 23 pages per minute (ppm) in black and 15ppm colour, it promises high print speeds, and has a wired Ethernet port in addition to USB and wireless interfaces. More

SPECIFICATIONS

TECHNOLOGY Thermal inkjet

MAXIMUM PRINT RESOLUTION 600x1,200dpi

MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH) 1,200x1,200dpi

DIMENSIONS 291x463x394mm

WEIGHT 11.4kg

MAXIMUM PAPER SIZE A4/legal

WARRANTY One year RTB

DETAILS www.canon.co.uk

PART CODE 9627B008AA

Mixed colour speed

6.3ppm

Colour costs

4.1p

0% -50 Reference +50 +100
See page 72 for performance details



significantly, this model accepts high-capacity inks, which should mean lower running costs.

The MB5050 is striking, with a front panel that looks like machined alloy despite being made from plastic. The 50-page automatic document feeder (ADF) folds shut when not in use, and the hinges of the scanner lid extend so it can close flat on thick documents. The ADF can scan only one side of a document automatically, but the printer does support duplex printing. The fully enclosed 250-sheet paper input has an output tray above it, but there's no bypass feed for special media.

The colour touchscreen is paired with a few dedicated function buttons, but the screen is small and not very responsive. The prominent Cloud icon gives quick access to online services such as Dropbox or Google Drive, and there's support for mobile devices through AirPrint, Google Cloud Print, iOS and Android apps.

In certain areas, the MB5050 performs brilliantly. It's an extremely quick mono device,

delivering 25 pages of text at 21.4ppm, and a single mono photocopy in just eight seconds. 10 pages took only 48 seconds. Scans are fast at low-to-middling resolutions, with a 300dpi A4 capture taking just 14 seconds, but a 1,200dpi photo scan took 68 seconds. Colour print speeds are swift, but not exceptional, with our 24-page graphics test arriving at 6.3ppm. It took almost four minutes to duplex print 10 colour sides on five pages, however.

Scan quality is high, and mono prints and copies are also good, but colour prints and copies on plain paper were disappointing. While the image is quite strong on the page, colours seem drab compared to its rivals. Print costs are good though, at about 4.1p for a page of mixed text and graphics, of which the black component is just 0.9p.

These low costs make the MB5050 a fair choice, but we'd rather pay another £50 or so for Epson's WorkForce Pro WF-5620DWF.

Simon Handby

INKJET PRINTER

HP Officejet Pro 6230



RECOMMENDED £47 inc VAT • From www.uk.insight.com

VERDICT

Cheap, swift and inexpensive to run, the Officejet Pro 6230 is a no-nonsense office inkjet

HP'S OFFICEJET PRO 6230 is a no-frills inkjet, aimed at small offices and the home. Support for wired and wireless networking makes it easy to share on a network, and there's also automatic duplex (double-sided)

SPECIFICATIONS

TECHNOLOGY Thermal inkjet

MAXIMUM PRINT RESOLUTION 600x1,200dpi

DIMENSIONS 146x464x385mm

WEIGHT 5.1kg

MAXIMUM PAPER SIZE A4/legal

WARRANTY One-year RTB

DETAILS www.hp.co.uk

PART CODE E3E03A#A81

Mixed colour speed

4.4ppm

Colour costs

5.4p

0% -50 Reference +50 +100
See page 72 for performance details



printing. The only obvious omissions are a screen and a USB host port, which would enable direct printing at the device.

This isn't a small inkjet, and the grey plastic finish looks a little clunky. We could also hear a constant high-pitched noise from the mains adapter until we unplugged our review sample.

The large top panel opens up for easy access to the paper path for clearing jams. This is also how you reach the four ink cartridges. You can fit high-capacity replacements good for 1,000 black pages or 825 of each colour. Using these, running costs are 5.4p for a page of mixed text and graphics, of which the black component is 1.6p. Not the best, but very competitive for a cheap printer.

We're not keen on paper trays that can't be removed, and it's a shame the captive one here is rated for 225 pages. That said, it's easy to load and appears sturdy. Above it, a simple panel of buttons and indicators covers mobile

printing, alongside more conventional functions such as cancelling a job.

This is a quick printer for the money, delivering 25 pages of black text at 17.6ppm, and 24 pages of colour graphics at a less impressive 4.4ppm. It was less competitive when duplexing, needing 3m 45s to print 10 sides on five sheets of A4. The results were also noticeably fainter than with simplex prints. Otherwise, print quality is very good, with sharp black text and vice-free colour graphics. While draft printing was no quicker than standard quality, the results, though more faint, would be adequate for formal letters if ink saving was paramount.

While it's not exactly exciting, there's little to criticise about the Officejet Pro 6230. Cheap to buy and run, it's a good choice if you need to print reasonable volumes of office documents or letters on a low budget.

Simon Handby



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up to **128GB** storage

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Max Capacity
960GB



Easy DIY install



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Memory Upgrades for Mac JetMemory™

Max Capacity
128GB



Designed for
more serious tasks



100% compatible



ULTRA-THIN EXTERNAL HARD DISK

SEAGATE Seven



£100 inc VAT • From www.ebuyer.com

VERDICT

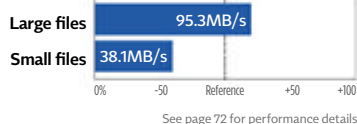
The Seagate Seven is incredibly thin and stunning to look at, but performance is average and the price is high

WITH A STAINLESS steel chassis just 7mm thick, the Seagate Seven is the thinnest portable drive in the world with a mechanical hard disk inside. It's slimmer than a phone, so you'll have no trouble slipping it in your pocket.

The drive comes with a braided USB cable, and the single blue activity LED is subtle

SPECIFICATIONS

CAPACITY 500GB
COST PER GIGABYTE £0.20
INTERFACE USB3
WARRANTY Two years RTB
DETAILS www.seagate.com
PART CODE STDZ500400



enough not to be distracting. You can disable this through Seagate's software if you prefer.

In order to make such a slim drive, Seagate has used a 5mm hard disk, which spins at 5,400rpm and has 16MB of cache. The Seven is only available in one capacity, so if 500GB isn't enough you'll need a different disk.

The 5,400rpm spin speed means the drive won't break any performance records. In our tests, it wrote large files at 84.6MB/s and read them at 105.9MB/s – a distinctly average result from a mechanical disk. Small file speeds were unsurprisingly slower, but 20.6MB/s writes and 55.6MB/s reads are still better than average for a portable hard disk.

The Seven comes with Seagate's Dashboard software suite, which lets you set automatic data backups on both PC and Mac. By default it scans your User, Documents, Music, Pictures and Video directories, but you can add specific folders if you store your files

elsewhere. Backups can be scheduled, or you can set the program to monitor folders for changes. Both settings worked well during our tests and the application is easy to use. The flipside of this ease of use is that the program is incredibly simplified; if you need finer control or want to back up multiple user accounts you'll need to find a third-party tool.

Dashboard also works with Seagate's iOS and Android Mobile Backup apps, backing up photos and videos you've snapped on your smartphone automatically when phone and computer are connected to the same network.

At 20p per gigabyte, the Seagate Seven is expensive; you can find a multitude of 500GB USB3 hard disks for less than half the price if you don't mind a chunkier disk. If you want a hard disk that makes a statement it's one of the best looking around, but for everyone else the £50 Toshiba StorE Canvio is better value.

Tom Morgan

TWO-BAY NAS

SYNOLOGY DiskStation DS215j



BEST BUY £149 inc VAT • From www.ebuyer.com

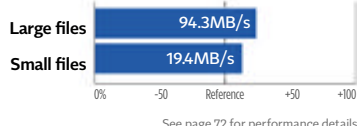
VERDICT

Performance is outstanding and Synology's DSM interface continues to impress: the DS215j is an excellent home NAS

THE DISKSTATION DS215J has room for two 3½in disks for a maximum capacity of 12TB, but will accept 2½in disks, too. Installing hard disks takes slightly more effort than in other NAS devices, as you have to open the chassis

SPECIFICATIONS

CAPACITY N/A
3½in DISK BAYS (FREE) 2 (2)
NETWORKING 10/100/1,000 Ethernet
DLNA MEDIA SERVER Yes
PRINT SERVER Yes
DIMENSIONS 165x100x226mm
WEIGHT 870g
WARRANTY Two years RTB
DETAILS www.synology.com
PART CODE DS215j



and screw the disks into a cage. There are no tool-free rails or quick release trays.

You also need to install the DSM operating system manually. Go to find.synology.com from any PC on the same network as the NAS and it will search for networked devices and walk you through the setup process, including downloading the latest version of DSM.

DSM is sensibly laid out and customisable. Synology's comprehensive package centre lets you add applications such as media servers, mail clients, IP camera controls and a full set of multimedia playback tools, which can be accessed outside your home network via your smartphone after a very simple setup process.

We tested the DS215j using WD Red hard disks, which are designed for NAS devices, configured in Synology Hybrid Raid mode. This is similar to RAID 1, where your data is mirrored between two disks to ensure you don't lose data if one disk fails. You can manually configure the NAS as RAID 0, which

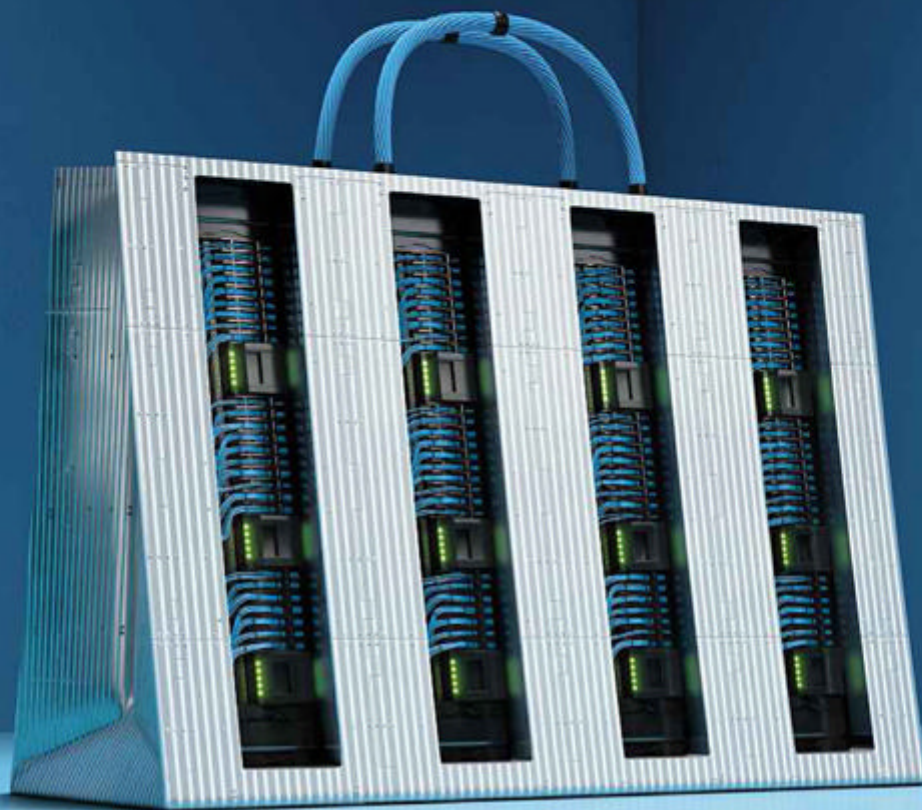
creates a larger combined storage volume and has potential speed benefits, but if one disk fails you lose all your data.

In performance terms, the DS215j gives the more expensive DS214+ a run for its money, with large file write speeds of 88.4MB/s and read speeds of 100.1MB/s. NAS devices are slower to transfer small files, but write speeds of 14.8MB/s and reads of 24MB/s were actually faster than the more expensive unit.

Synology hasn't changed its basic design for some time, so there's a power button and activity LEDs at the front, and Gigabit Ethernet and two USB ports at the back. One is the faster USB3, and is better suited to external hard disks for adding extra storage capacity.

The DS215j is reasonably priced, even once you factor in the cost of disks, and it's fast. DSM is the best NAS operating system we've used, making the DS215j the obvious choice if you don't mind installing the disks yourself.

Tom Morgan



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802.11n ADSL/VDSL ROUTER

DRAYTEK Vigor 2760Vn



£134 inc VAT • From www.dabs.com

VERDICT

Plenty of business-friendly features, and VDSL support is a welcome inclusion, but wireless connectivity is limited

DRAYTEK TAKES A business-first approach to its routers, prioritising features and security over raw speed, and the Vigor 2760Vn is no exception. It might be limited to 2.4GHz 802.11n Wi-Fi when most of the competition has already made the jump to 5GHz 802.11ac, but VoIP support, a robust firewall and highly configurable QoS settings mean it can't be ruled out if you need reliable hardware.

The 2760Vn can be used as a modem/router for ADSL and VDSL connections, meaning BT Infinity customers can ditch their BT-supplied fibre modem and use the Vigor instead; useful for anyone who doesn't want to use two devices. You'll need your BT username, which can be found in the Advanced Settings page on the Home Hub web interface, and will have to enable a few settings on the 2760Vn to get up and running. Annoyingly you'll need to create an account to read Draytek's instructions, which are available from tinyurl.com/vigor2760vn.

WILLING AND CABLE

The 2760Vn can also act as a cable router, though you'll still need a cable modem to get online. Switching one of the Ethernet ports to a WAN port is a time-consuming process, as the router has to reboot multiple times while you disable some settings and enable others.

As well as four Gigabit Ethernet ports, the 2760Vn has two USB ports on the rear for

attaching external storage, a network printer share, or compatible 3G or 4G modems to automatically provide internet access if your broadband connection fails. Not all dongles are supported, but the setup page has a comprehensive list of the ones that are.

USB storage setup is slightly convoluted; your device must be formatted as FAT32, and you can only access your files through an FTP server. While this is standard for an office environment, it's a pain that home users can't mount their disks as network drives.

CALL CENTRE

You'll also find two RJ11 phone sockets on the side of the device, which can be used for making VoIP calls. Setting up a SIP client isn't as straightforward as signing up for Skype, using FaceTime or Google Hangouts, but once you have an account (we used www.getonsip.com) and have plugged in a landline phone, you can make free calls over the internet to other SIP users. You can also call other PCs using a free client such as Jitsi (jitsi.org) or to tablets and phones with various other apps.

Wireless performance is disappointing. With no 802.11ac, or even 5GHz wireless N, we were limited to 802.11n on the 2.4GHz frequency. At 10m we managed only 11.8MB/s, dropping to a very low 5.3MB/s at 25m. Disabling channel bonding didn't improve things, and the 2760Vn can't auto-detect the best wireless channel to use, meaning you'll need to use a third-party wireless signal strength-tester to check for interference.

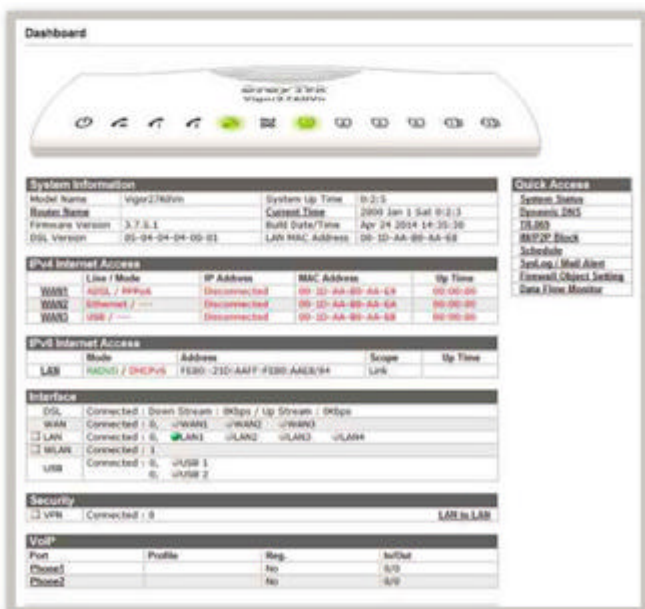
Moving as close to the router as possible, we achieved a more respectable 52MB/s, meaning you should be able to work in the same room at reasonable speeds. Of course, our testing environment is a worst-case scenario, so speeds will likely

improve in areas with less interference from other wireless networks and devices.

The 2760Vn can run up to four separate wireless networks, with one designated as a guest network by default. You can isolate each network from the others and direct them to separate VPNs. The web interface has a variety of port forwarding and static IP options, and optional content filters to prevent access to specific content, although it's still a convoluted process and the UI doesn't provide much in the way of assistance. The whole interface is rather basic, with the only helpful diagram replicating the lights on the front of the router for diagnosing issues. Unless you're familiar with IP Object Profiles and Trusted CA Certificates, you'll need to refer to the manual frequently to truly make use of all the 2760Vn's features. It's also rarely obvious when additional menus are buried within links or shortcuts, meaning you'll spend a lot of time searching for a particular setting.

Speed was never going to be the 2760Vn's defining feature, but we were still disappointed by wireless performance. However, it makes up for this in other ways, particularly if you're looking for an all-in-one router to manage VoIP accounts or control multiple virtual networks in a small office. That being said, home users will be better off with the faster, friendlier ZYXEL NBG6716 (see *Shopper 323*).

Tom Morgan



↑ The interface has an astounding array of options and menus, and the dashboard is useful for at-a-glance troubleshooting when problems occur



SPECIFICATIONS

MODEM ADSL2+, VDSL2
WI-FI STANDARD 802.11n
STATED SPEED Not stated
USB PORTS 2x USB
WALL MOUNTABLE Yes
WARRANTY Two years RTB
PART CODE V2760N



See page 72 for performance details

INTEL LGA1150 MOTHERBOARD

GIGABYTE Z97X-UD5H-BK

COMPUTER
SHOPPER
RECOMMENDED



£169 inc VAT • From www.scan.co.uk

VERDICT

Reliable, with great performance and an unbeatable warranty – a great choice for anyone who wants to build a rock-solid PC

GIGABYTE'S 'ULTRA DURABLE' Black Edition motherboards are certified for a full seven days of use in servers and workstation PCs, but thanks to support for dual graphics cards, gaming-grade Killer networking chips and plenty of overclocking options, the Z97X-UD5H-BK is also a full-featured board for home users. The all-black colour scheme is offset with yellow highlights on the heatsinks around the processor, which look menacing when viewed through a case window.

The board's LGA1150 socket supports both 4th and 5th generation Intel Core processors, meaning it will accept a Haswell CPU now and be ready for when Broadwell finally launches later in the year. Twin fan headers let you fit a CPU cooler with two fans without having to run cables across the motherboard, and there's room around the processor socket for large air coolers. Four RAM slots support up to 32GB of DDR3 memory running at 1.6GHz, and will run overclocked memory up to 3GHz.

FACE THE FRONT

In addition to the eight SATA3 ports, the Z97X-UD5H-BK also has a single SATA Express connector and an M.2 slot for SSDs, although using the M.2 slot will disable two of the SATA ports. All the SATA ports face outwards rather than upwards, so you may want to connect your cables before installing the board to avoid fiddly installation later.

There are lots of other connection options, with six USB3 and two USB ports on the rear, plus one USB3 and two USB headers on the board itself for adding more. DVI, HDMI and VGA outputs will let you connect the board to most displays if you plan on using your CPU's integrated graphics, but with three PCI-E x16 slots there's scope for adding a graphics card or two. The slots all share bandwidth, so will reduce to x8 speeds with two graphics cards installed in an SLI or CrossFire configuration.

With our reference components (an Intel Core i5-4670K, 8GB of RAM and an AMD Radeon R7 260X graphics card) installed and running at stock speeds, the Z97X-UD5H-BK scored 95 overall in our multimedia benchmarks. That puts it slightly behind our reference board, but still capable of running demanding tasks such as video editing.

CLOCK THAT

The Z97X-UD5H-BK is well suited to overclocking, with a second BIOS chip acting as backup in case you push your components too far. An LED POST code display, voltage measurement points and an on-board power button will let you squeeze every ounce of power out of your kit. However, with no button to clear the CMOS on the rear, you'll still have to open up your PC after a failed boot.

The board's UEFI BIOS is easy to navigate and all the settings are sensibly labelled, so

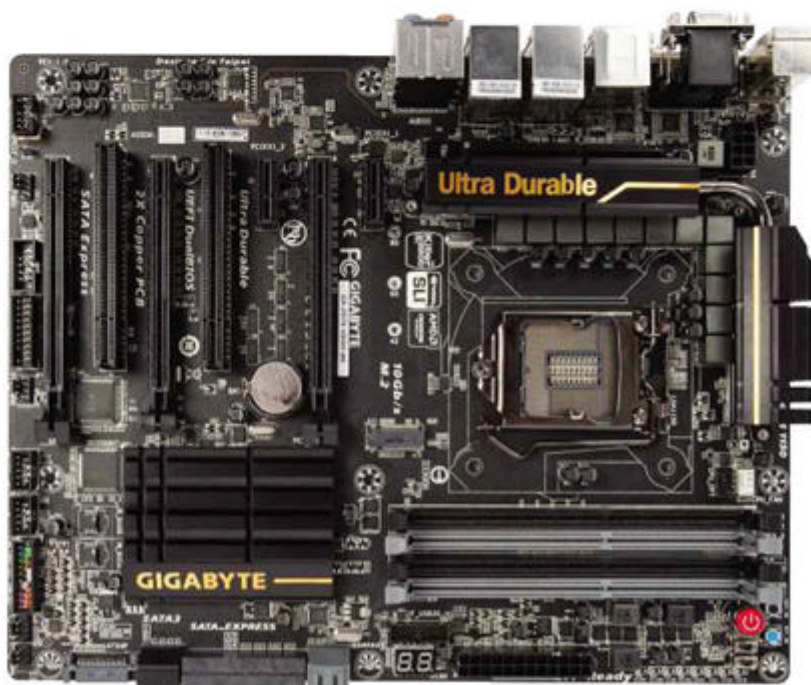
you won't have to reach for the manual when you want to make changes. There is an automatic overclocking mode, but for more precise control you can manually change CPU, RAM, chipset and VGA clocks and voltages.

We overclocked our Core i5-4670K to 4GHz simply by increasing the multiplier, with no need to mess around with core clocks or voltage settings in the BIOS. This resulted in a healthy performance boost in our multimedia benchmarks to 114, and a 3fps increase in Dirt Showdown. We managed these overlocks with the stock Intel CPU cooler, so a more efficient air cooler or water-cooling system could turn the board into a serious powerhouse; temperatures were the only thing stopping us from going further.

This motherboard is a great performer, whether you go for stock speeds or overclock your components, but the biggest reason to buy a Z97X-UD5H-BK is Gigabyte's fantastic upgrade offer. Anyone registering their Black Edition board purchase qualifies for a five-year extended warranty, and is eligible for a free upgrade to an equivalent motherboard in the range at any time in the next three years.

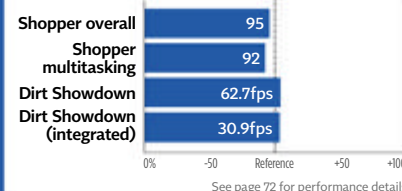
With its reliability and connectivity, the Z97X-UD5H-BK is one of the best-value Z97 motherboards you can buy. If your budget won't stretch this far, however, Asus's Z97-E (Shopper 327) is a keenly priced alternative.

Tom Morgan



SPECIFICATIONS

PROCESSOR SOCKET LGA1150
DIMENSIONS 305x244mm
CHIPSET Intel Z97
MEMORY SLOTS 4
PCI-E x16 SLOTS 3
PCI-E x1 SLOTS 2
PCI SLOTS 2
USB PORTS 6x USB3, 2x USB
VIDEO OUTPUTS VGA, DVI, HDMI
WARRANTY Three years RTB
DETAILS www.gigabyte.com
PART CODE GA-Z97X-UD5H-BK



PROPELLERHEAD

Reason 8



£269 inc VAT • From www.dv247.com

VERDICT

A lacklustre update, but Reason is still enormous fun to use and it sounds superb

WHEN REASON FIRST appeared in 2000 with its armory of fantastic-sounding synths and effects, it was clear the writing was on the wall for hardware studios. It sounds just as exciting and relevant today, but still retains its visual and operational references to studio hardware. A virtual rack of equipment is connected using animated virtual cables, and it even includes rack screws and wood end panels to hold everything in place.

For years Propellerhead resisted calls for live audio recording and third-party plug-in support, but these are now included, so in many respects Reason stands alongside the likes of Cubase and Sonar as a general-purpose recording environment. It can't match Cubase and Sonar for the power and flexibility of its audio-editing tools, but its virtual instruments, effects and mixer compare well.

The reworked interface in Reason 8 is apparently designed to let users think less about software and more about the music. It's an excellent ambition but the changes aren't as far reaching as we might have expected.

Previously the Browser was a floating panel that housed Quantise and various other functions. It's now docked on the left of the screen, and is better integrated with the rest of the interface. There's extensive use of drag and drop – to create or replace an instrument or effect, load a sample into an instrument and so on. Clicking the Preset Load button on



↑ The new Browser supports drag and drop to the Rack or Sequencer to add modules and load samples

a module in the rack reveals the relevant presets in the Browser. Sequencer tracks and Mixer channels automatically take the name of the preset that's loaded. It's also possible to organise presets into custom lists to help you find your favourites for a particular task.

SEARCH PARTY

It's intuitive, but it could have gone further. Instruments can only be auditioned by loading them, whereas Cubase lets you play them with a MIDI keyboard in its browser window. Reason also lacks Cubase's metadata for presets, so text searches are only useful if you remember the name of a preset. You can't search by genre or properties, for example.

The Browser panel can be hidden, as can the panels for the Mixer, Rack and Sequencer. However, it seems odd that these three are stacked vertically. A short, wide space makes sense for the Sequencer but the Mixer and Rack don't fit these spaces well. The Mixer and Rack can be undocked, and with the three windows spread across two 1080p monitors, the interface makes more sense.

Sadly Propellerhead hasn't changed the mixer interface, which is modelled on a hardware mixing desk. It looks the part but at 2,000 pixels high, lots of scrolling is required to see all the settings for each channel. The mixer is crying out for a pop-up channel editor with descriptive representations of the functions. There's a pop-up graphical EQ editor, and it's easier to use than the mixer's knobs and buttons.

The Sequencer has some workflow improvements of its own. Ctrl-dragging an object now copies it to the new location. In the MIDI editor, double-clicking an empty space creates a new

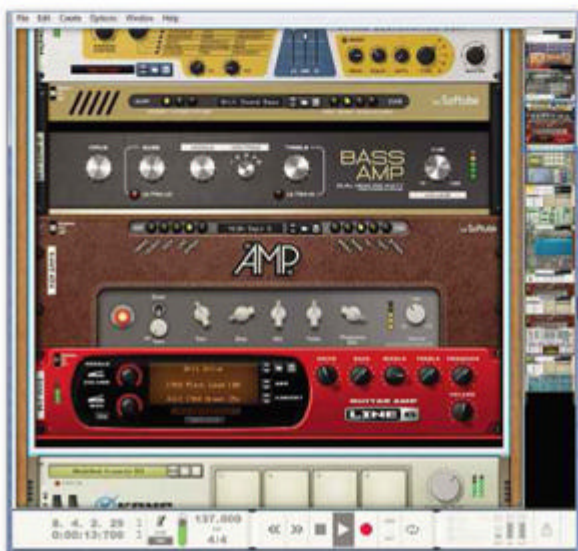
note, while double-clicking a note deletes it. You can also now drag notes from either end to resize them. Other limitations remain, though. Automation is basic compared to rival software. The Sequencer and Mixer mute and solo buttons work independently of each other, which can lead to confusion. The mouse wheel is used to scroll and zoom the Sequencer timeline in various ways, but there's no shortcut to zoom in and out.

VIRTUOSO PERFORMER

Reason's trump card has always been the quality of its virtual instruments, and that's still the case in version 8. It's disappointing to find nothing new in this release, though. The only new modules are a pair of effects for guitar and bass amp simulation. These replace the existing effects from Line 6, which are scheduled to disappear from the software by October 2016. The new effects have to be downloaded (for free) as Rack Extensions from the Propellerhead website. Most other Rack Extensions are by third-party developers but some are home-grown Propellerhead modules. Modules such as the Parsec Spectral Synthesizer might previously have been included, but instead it's a €99 upgrade.

Our criticisms should be seen in context. Reason 7 was a great success, and Reason 8 is even better. However, the improvements are modest considering the €129 (about £95) upgrade price – and in light of the other improvements that could have been made. Even so, if your main interest is in electronic music production, it's an excellent choice.

Ben Pitt



↑ The Softube Amp and Bass Amp modules are welcome, but we'll soon be saying goodbye to the equivalent Line 6 modules

SPECIFICATIONS

OS SUPPORT Windows 7 or later, Mac OS X 10.7 or later
MINIMUM CPU Intel or AMD dual-core
MINIMUM GPU N/A
MINIMUM RAM 4GB
HARD DISK SPACE 3GB
DETAILS www.propellerheads.se

VIDEO-EDITING SOFTWARE

COREL VideoStudio X8 Ultimate



£80 inc VAT • From www.videostudiopro.com

VERDICT

Lots of small improvements, but not the ones we were hoping for

VIDEOSTUDIO HAS BEEN a stalwart of consumer video editing since the 1990s. Now on its 17th version, it has accrued a mass of features but maintains its beginner-friendly appearance. The last update improved performance and the interface, but this time the focus is on new features and creativity. In practice, there's no headline-grabbing new feature but a decent helping of smaller ones.

New overlay options now sit alongside the existing Mask and Chroma key modes. Gray Key makes pixels on an upper layer more or less visible depending on their brightness. There's precise control over the threshold using five handles on a greyscale bar (the Chroma Key effect gains these controls too) but the slow response to changes didn't help our efforts to master them.

The new Multiply and Add modes are similar to Photoshop's Blend Modes, overlaying colours so elements of both clips show through. We were initially thrown by the software's habit of reducing the upper layer's Opacity to 50% by default; 100% tends to work better for these modes. These options would have been ideal for Titles objects but sadly this is not allowed by the software.

Another option is to use a video file as a mask, with brightness mapped to opacity – perfect for making video appear inside text. The manual describes how animated titles can be converted into UISX files for this very purpose, but it's a long-winded process and there's zero chance of discovering it unless you happen to read p124 of the online manual. Premiere Elements' Track Matte Key effect allows one video track to be used as a mask for another, which is much more elegant.



The NewBlue ColorFast plug-in is much better than the crude built-in colour correction, but it's not beginner-friendly

DUCKING AND DIVING

Audio ducking lowers the volume of an audio source so it doesn't overpower another. Typically it's applied to music to make way for speech. A new Audio Ducking option in the right-click menu for audio tracks is reasonably straightforward to use, although not everyone will understand what the controls do. Volume envelopes are applied to the music track to lower and raise its volume, and these can be edited manually. Only audio files have the right-click option, so video soundtracks can't apply ducking to make way for narration.

The new Lens Correction effect is well timed considering the popularity of action cameras, many of which have fish-eye lenses. We struggled to get useful results from it, though. There are no profiles for popular cameras, the pop-up editor is slow to respond and controls lack the precision we'd hoped for.

At least the new Freeze Frame feature is simple and effective. Position the playback bar, select the option from the right-click menu and the software splices a bitmap of that frame into the timeline. There's an inevitable gap in the audio, but the Split Audio command allows the video and audio components of a clip to be edited independently.

It was already possible to drop VideoStudio project files on to the timeline to create a nested sequence within a sequence. Now there's an option to unpack the project

file to access its individual elements, which is handy for merging two or more projects together. Other new features include a Favorites folder for organising effects for quick access, and the ability to show media properties in the Media bin.

The Ultimate edition of VideoStudio X8 includes a range of plug-ins from third-party developers. Quality is



Audio Ducking reduces the volume of music so it doesn't obscure dialogue

generally high but these plug-ins' controls are at odds with VideoStudio's beginner-friendly ethos. The new proDAD Adorage Starter Pack provides an assortment of transition templates, complete with cheesy animated graphics such as hearts, balloons and wedding bouquets. The interface is needlessly complex and it's baffling that this plug-in appears in VideoStudio as both a transition and an effect. NewBlue FX Essentials IV is also new and comprises ten effects, including a Magnifying Glass for highlighting details in a clip, and another that makes video look like it was shot at night time.

TAKING ISSUE

Once again, VideoStudio scores for quantity rather than quality. The new features bring only small benefits and various longstanding issues remain unresolved. Colour-correction quality is crude and its controls can't be automated. The pop-up editor used for other effects is clunky and applies keyframe automation even when it's not needed. The confusing ripple-editing options mean objects on overlay tracks easily wander out of sync.

Preview performance is temperamental, with 1080p AVC footage from some cameras playing back far more smoothly than others. As with previous versions, the controls can be slow to respond when editing larger projects. It's worryingly easy to have media, project and export settings all at different resolutions and frame rates, which can lead to degraded details and dropped or repeated frames.

VideoStudio may look beginner-friendly, but Adobe Premiere Elements (see *Shopper* 323) and Sony Movie Studio Platinum (see *Shopper* 315) offer much more both for beginners and advanced users.

Ben Pitt

SPECIFICATIONS

OS SUPPORT Windows XP/Vista/7/8
MINIMUM CPU Intel Core Duo 1.83GHz (Core i5 recommended)
MINIMUM GPU 1GB
MINIMUM RAM 2GB (4GB recommended)
HARD DISK SPACE 3GB
DETAILS www.videostudiopro.com
PRODUCT CODE B00T5J6ZMY

GEARBOX SOFTWARE

Homeworld Remastered

COMPUTER SHOPPER

★★★★★

RECOMMENDED £27 inc VAT • From store.steampowered.com

VERDICT

Beautifully updated graphics and sound will appeal to old Homeworld fans and new players alike

HOMEWORLD WAS A sensation among PC gamers when it launched in 1999. The sci-fi RTS had beautiful graphics, a moving soundtrack and a story brought to life by impressive voice acting and cinematic cut-scenes. What's more, Homeworld seemed to achieve the impossible by making 3D real-time combat in space not only comprehensible, but fluid and exciting, too.

Sixteen years later, Gearbox has remastered both Homeworld and its 2003 sequel, Homeworld 2. Both games run on a modified version of the Homeworld 2 engine, but with super-high-resolution textures and plenty of fancy graphical effects.

SHIFTING SANDS

Homeworld's protagonists, the Kushan, live on a desert planet, but one day find the wreck of a huge spaceship buried in the desert sands. A stone galactic map inside shows that the arid Kharak isn't the original home of the Kushan people. This knowledge unites the planet in building a giant colony ship to find its true homeworld: Hiigara.

The ship's launch is marred when an unknown enemy turns up and firebombs the entire planet. What follows is the desperate flight of the mothership across the galaxy pursued by a genocidal enemy, with plenty of encounters with other beings along the way.

Homeworld 2 follows a similar pattern, but gives you a chance to save Hiigara through your heroic actions. Homeworld 2 was

generally considered to be inferior in terms of plot and atmosphere, but we still enjoyed building up our fleet and taking the fight to Makaan and his vicious Vaygr fanatics.

Your mothership must be protected at all costs, but it's far from a simple colony transporter; it can be used to construct ever more powerful ships, from fighters to frigates and destroyers. Each ship type has its own strengths and weaknesses, and a balanced fleet is vital: your ion frigates may demolish enemy carriers, but nimble enemy bombers will evade your slow-to-target ion beams.

SHIP OF TOOLS

Your economy relies on harvester vessels collecting bits of asteroid and other materials. You're not awash with resources, and you carry your fleet from mission to mission, so you need to guard your ships well: small, cheap fighters are expendable, but losing a frigate or a destroyer can make life difficult in the next fight. If you're feeling sneaky you can use salvage corvettes to capture enemy ships mid-battle, and robbing a couple of enemy destroyers to add to your fleet can really tip the balance in your favour in the next mission.

Controlling a fleet in three dimensions isn't as hard as it sounds. Your ships mainly sort themselves out when you issue attack orders, but moving to a specific point in space is trickier. After setting the x and y coordinate with a click, you hold down shift and move the mouse to set the point on the z axis you want

your ship to end up. This isn't something you'll do a lot, as you're too busy fending off threats to worry about tactical manoeuvres.

One big change from the original game is that ships are much more lax about keeping in formation. In Homeworld you could set your fighters to form a protective circle around a capital ship and they would do their utmost to keep formation. Here, fighters form a vague circle around your precious capital ship, then forget about the formation as soon as they get into combat. Using formations just isn't as satisfying as in the original Homeworld.

IF LOOKS COULD THRILL

The graphics, however, are lovely. Textures are hugely high-res, there are some impressive lighting effects, and unlike the original the game runs properly at modern monitor resolutions. The graphic novel-style cut-scenes have also been redone, and the wonderful speech and music is clearer than ever.

We did, however, have some performance problems. We managed a playable 65-75fps running at 2,560x1,440 with everything turned up to maximum on a system with a Radeon HD 7950 graphics card, but the cut-scenes were jerky and stuttering at these settings. The only way to smooth them out was to sacrifice in-game detail; we wish there was more of a balance between the cut-scenes and the game in terms of rendering difficulty.

As long as you're prepared to tweak the graphics settings to get the best experience, Homeworld and Homeworld 2 Remastered stand up as superb, atmospheric and fun space operas with excellent plots, exciting seat-of-your-pants gameplay and a real feeling that you're part of a life-and-death struggle against the odds. We hope that Gearbox can tweak the in-game cut-scene performance and squash a couple of bugs, as these are two games that, with graphics brought into this millennium, still stand up to RTS scrutiny.

Chris Finnamore



▲ Assault frigates are vital for defending against waves of fighters

SPECIFICATIONS

AVAILABLE FORMATS PC
OS SUPPORT Windows Vista/7/8
MINIMUM CPU 2.2GHz dual-core
MINIMUM GPU Nvidia GeForce 8800 GTS/ATI Radeon HD4800
MINIMUM RAM 1GB
HARD DISK SPACE 20GB
DETAILS www.homeworldremastered.com
PRODUCT CODE Homeworld Remastered Collection

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Choosing a ...

Laptop computer

01 A basic laptop costing around £300 will run everyday office, multimedia and education software, but it won't be suitable for 3D gaming. Many laptops at this price have a 15.4in screen and weigh around 2.4kg, so they're best used around the house and for occasional journeys.

02 If you want to play modern games, you'll need a laptop that has a dedicated graphics chip such as the Nvidia GeForce GTX 860M. Good gaming laptops tend to have large 17in screens and weigh around 3kg, so they're best suited to the home.

03 If you want a laptop that you can take everywhere, look for a model that weighs less than 2kg. For the best portability, look for one with an 11in or 13in screen. In general, the smaller and lighter the laptop, the more expensive it is, especially if you want a model with plenty of processing power.

04 Battery life is extremely important for a laptop. We'd expect all but the biggest and heaviest to last for at least five hours on a single charge, but for an ultra-portable that you carry everywhere, eight hours and above is more desirable.

05 Laptops use the mobile versions of processors to conserve power, and these lag behind desktop chips for performance. For a budget laptop, an Intel Core i3 processor will do the job, but if you want better performance, look for an Intel Core i5 or Core i7 model instead. We recommend a minimum of 4GB of RAM, although 8GB is better for multitasking.

06 Most budget and mid-range laptops have a regular hard disk for storage. You want at least 500GB, but 1TB or more is better. SSDs have faster performance, making your computer much faster to boot. SSD capacity is lower, though, and you'll need at least 128GB.

07 Netbooks are a type of small, low-cost ultra-portable laptop. They're fine for light use, but avoid them if you want to do complicated tasks.

PCs



CHILLBLAST Fusion Raptor

★★★★★

£1,099 inc VAT • www.chillblast.com

The Chillblast Fusion Raptor comes in a gorgeous case and manages to successfully marry great application performance and scintillating gaming gusto. It uses some impressive components and is great value.

PROCESSOR Quad-core 4.4GHz Intel Core i7-4790K (overclocked) • **RAM** 16GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 2x USB, 4x USB3 • **TOTAL STORAGE** 120GB SSD, 2TB hard disk • **GRAPHICS CARD** MSI GeForce GTX 960 Gaming 2G • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Five years (Three years collect and return, two years RTB) • **DETAILS** www.chillblast.com • **PART CODE** Fusion Raptor • **FULL REVIEW** May 2015



APPLE Mac Mini (2014)

★★★★★

£569 inc VAT • store.apple.com/uk

The Mac Mini (2014) has great performance for a compact system. It has stunning looks thanks to its beautiful curved edges made from a single block of aluminium. It's a worthy update to the Mac Mini range and a good choice for those looking for their first Apple Mac computer.

PROCESSOR Dual-core 2.6GHz Intel Core i5-4278U • **RAM** 8GB • **FRONT USB PORTS** 0 • **REAR USB PORTS** 4 • **TOTAL STORAGE** 1TB hard disk • **DISPLAY** None • **OPERATING SYSTEM** Mac OS X 10.10 • **WARRANTY** One year RTB • **DETAILS** www.apple.com • **PART CODE** Mac Mini A1357 • **FULL REVIEW** Feb 2015



PALICOMP i5 Devil Blaster

★★★★★

£700 inc VAT • www.palicom.co.uk

Palicom has created an eminently powerful system for the money. The i5 Devil Blaster has terrific gaming performance and the system's overclocked i5-4690K processor provides great application performance as well. A decent monitor rounds off a great-value system.

PROCESSOR Quad-core 4.5GHz Intel Core i5-4690K (overclocked) • **RAM** 8GB • **FRONT USB PORTS** 1x USB3, 1x USB • **REAR USB PORTS** 4x USB3, 2x USB • **TOTAL STORAGE** 1TB hybrid hard disk • **GRAPHICS CARD** 2GB PowerColor AMD Radeon R9 270X • **DISPLAY** 24in Iiyama ProLite E2483HS • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Three years RTB, one year parts • **DETAILS** www.palicom.co.uk • **PART CODE** HAS8 • **FULL REVIEW** Dec 2014



LAPTOPS



ASUS EeeBook X205TA

★★★★★

£180 inc VAT • www.argos.co.uk

Asus's answer to the Chromebook is a resounding success. It's not the most powerful laptop in the world and its on-board storage is tiny, but in return you get a supremely light Windows 8 laptop and a year of Office 365 worth £60. Perfect for light users who use a laptop for document editing.

PROCESSOR Quad-core 1.33GHz Intel Atom Z3735F • **RAM** 2GB • **SIZE** 286x193x18mm • **WEIGHT** 980g • **SCREEN SIZE** 11.6in • **SCREEN RESOLUTION** 1,366x768 • **GRAPHICS ADAPTOR** Intel HD Graphics • **TOTAL STORAGE** 32GB eMMC • **OPERATING SYSTEM** Windows 8.1 with Bing • **WARRANTY** One year collect and return • **DETAILS** www.asus.com • **PART NUMBER** X205TA-BING-FD15B5 • **FULL REVIEW** Mar 2015



ACER Aspire V Nitro VN7-591G

★★★★★

£850 inc VAT • www.saveonlaptops.co.uk

Acer's re-entry into the world of stylish gaming laptops is a massive success. The Aspire V Nitro's attractive chassis, powerful components and competitive price make it a great laptop for anyone looking for a performance notebook.

PROCESSOR Quad-core 2.5GHz Intel Core i7-4710HQ • **RAM** 8GB • **SIZE** 389x257x24mm • **WEIGHT** 2.4kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Nvidia GeForce GTX 860M • **TOTAL STORAGE** 1TB hard disk (with 8GB SSD cache) • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** One year RTB • **DETAILS** www.acer.co.uk • **PART NUMBER** NX.MOLEK.002 • **FULL REVIEW** Apr 2015



TOSHIBA Chromebook 2 (CB30-B-104)

★★★★★

£270 inc VAT • www.johnlewis.com

Toshiba's Chromebook 2 is the first budget Chromebook on sale in the UK with a Full HD screen. This increases the price a little but we think it's absolutely worth it. With so much extra real estate, you can fit more items on the screen and get more done. The machine is lighter and has better battery life than its predecessor, too, making it our current favourite Chromebook.

PROCESSOR Dual-core 2.16GHz Intel Celeron N2840 • **RAM** 4GB • **SIZE** 320x214x19mm • **WEIGHT** 1.35kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel HD Graphics • **TOTAL STORAGE** 16GB SSD • **OPERATING SYSTEM** Google Chrome OS • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** www.toshiba.co.uk • **PART NUMBER** PLM02E-000003EN • **FULL REVIEW** May 2015



For more
PCs, see the
Group Test on
page 78

Choosing a ... Smartphone

01 A smartphone's operating system (OS) dictates its basic features and which third-party software you can install. There are three main contenders: Apple's iOS, which is found on the iPhone; Google's Android, which is used by various handset manufacturers; and Windows Phone 8, which is becoming more widespread and is a great alternative to Apple's and Google's operating systems. Apple iOS and Google Android have the most apps available, but Windows Phone is slowly catching up.

02 All smartphones have colour screens, but their resolutions vary. Basic models have 800x480 pixels, but text can be indistinct. Look for a display that has at least 1,280x720 pixels so that it's easy to browse web pages on your smartphone. Don't worry too much about built-in media players or Office document editors – you can always install apps to replace these with better versions later.

Cameras are common in smartphones, and resolutions have increased to as high as 20 megapixels. The image quality of smartphone cameras has improved tremendously in recent years.

03 Barely any modern smartphones have a physical keyboard for entering text; they almost exclusively use touchscreens. Physical keyboards can aid heavy emailing, but touchscreen keyboards work just as well now. Android smartphones and iPhones running iOS 8 let you install a variety of custom onscreen keyboards so you can find one that suits you.

04 Be careful when choosing a mobile contract. Look for one with a large data allowance if you want to use the internet regularly or you've set your phone to synchronise your contacts, calendar and email through online services such as Google's. Built-in Wi-Fi can help you avoid high data charges by connecting to the internet through wireless hotspots when you're out, or your router when you're at home. Android and iPhone handsets can operate as wireless hotspots, enabling you to connect your laptop to the internet over your mobile data connection. There may be an extra charge for this.

SMARTPHONES



SAMSUNG Galaxy S5

★★★★★

£325 SIM-free, free on £26.50-per-month contract • www.handtec.co.uk (SIM-free), www.carphonewarehouse.com (contract)

The Galaxy S5 is a great choice if you're looking to replace an old handset. Its outstanding battery life will keep you going all day long and its performance in our benchmarks is among the best we've seen.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 5.1in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 16 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 142x73x8mm • WEIGHT 145g • OPERATING SYSTEM Android 4.4 • PART CODE SIM-G900H • DETAILS www.samsung.com/uk • FULL REVIEW Jul 2014



SONY Xperia Z3 Compact

★★★★★

£401 SIM-free, free on £26.50-per-month contract • www.handtec.co.uk (SIM-free), www.carphonewarehouse.com (contract)

With its incredible 20-hour battery life and fast performance, the Sony Xperia Z3 Compact brings flagship features to a smaller handset at a great price.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 4.6in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 20.7 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 127x65x8.6mm • WEIGHT 129g • OPERATING SYSTEM Android 4.4 • PART CODE Sony D5803 • DETAILS www.sony.co.uk • FULL REVIEW Jan 2015



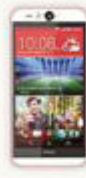
HTC Desire Eye

★★★★★

£318 SIM-free, free on £26.50-per-month contract • www.handtec.co.uk (SIM-free), www.carphonewarehouse.com (contract)

With its two 13-megapixel cameras, the Desire Eye is great for photography and selfie fans alike. It has quick internals to match HTC's flagship One (m8), and the bright, dual-colour unibody design looks great too.

PROCESSOR Quad-core 2.3GHz Qualcomm Snapdragon 801 • SCREEN SIZE 5.2in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 13 megapixels • STORAGE 16GB • WIRELESS DATA 4G • SIZE 152x74x8.5mm • WEIGHT 154g • OPERATING SYSTEM Android 4.4 • DETAILS www.htc.com/uk • PART CODE Desire Eye • FULL REVIEW Mar 2015



MOTOROLA Moto G (2nd Gen.)

★★★★★

£139 SIM-free • www.handtec.co.uk (SIM-free)

The Moto G has become even better. Now available with a larger screen, better camera and longer battery life, the new Moto G is the best budget smartphone available.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 3G • DIMENSIONS 141x70x11mm • WEIGHT 149g • OPERATING SYSTEM Android 4.4 • PART CODE XT1068 • DETAILS www.motorola.co.uk • FULL REVIEW Jan 2015



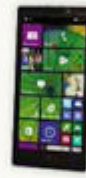
NOKIA Lumia 930

★★★★★

£325 SIM-free, free on £26.50-per-month contract • www.expansys.com (SIM-free), www.carphonewarehouse.com (contract)

The Lumia 930 benefits from a fantastic Full HD OLED screen, excellent performance and beautiful Nokia build quality. It also runs Windows Phone 8.1, which brings several improvements to the operating system.

PROCESSOR Quad-core 2.2GHz Qualcomm Snapdragon 800 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 20 megapixels • STORAGE 32GB • WIRELESS DATA 4G • DIMENSIONS 137x70x9.8mm • WEIGHT 167g • OPERATING SYSTEM Windows Phone 8.1 • PART CODE RM-1045 • DETAILS www.nokia.com • FULL REVIEW Oct 2014



TABLETS



SAMSUNG Galaxy Tab S 8.4

★★★★★

£250 inc VAT • www.currys.co.uk

The Galaxy Tab S 8.4 is a fast, compact tablet with an astonishing high-resolution screen. It's similar in price to the iPad Mini, but if screen quality is more important than app selection, this is the model to buy.

PROCESSOR Quad-core 1.9GHz Samsung Exynos 5 Octa (+quad-core 1.3GHz) • SCREEN SIZE 8.4in • SCREEN RESOLUTION 2,560x1,600 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 213x126x6.6mm • WEIGHT 294g • OPERATING SYSTEM Android 4.4 (KitKat) • WARRANTY One year RTB • PART CODE 107639 • DETAILS www.samsung.com/uk • FULL REVIEW Oct 2014



GOOGLE Nexus 9

★★★★★

£300 inc VAT • www.currys.co.uk

The Nexus 9 is the first Google-branded tablet to have an iPad-style 4:3 ratio screen, which we think is a better shape for web browsing. Android 5.0 Lollipop runs beautifully and its battery life is superb.

PROCESSOR Dual-core 2.3GHz 64-bit Nvidia Tegra K1 Denver • SCREEN SIZE 8.9in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 154x228x8mm • WEIGHT 425g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • PART CODE Nexus 9 • DETAILS www.google.com/nexus/9 • FULL REVIEW Feb 2015



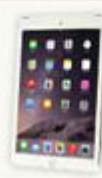
APPLE iPad Air 2

★★★★★

£399 inc VAT • store.apple.com/uk

The iPad Air 2 is even thinner and lighter than its predecessor and still feels beautifully made. It's the fastest iPad yet, and now has TouchID fingerprint recognition for added security. It's still the tablet to beat.

PROCESSOR Tri-core 1.5GHz Apple A8X • SCREEN SIZE 9.7in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 240x170x6.1mm • WEIGHT 437g • OPERATING SYSTEM iOS 8.1 • WARRANTY One year RTB • PART CODE Apple iPad Air 2 • DETAILS www.apple.com/uk • FULL REVIEW Feb 2015



MICROSOFT Surface Pro 3

★★★★★

£769 inc VAT • www.microsoftstore.com

If you want the best of both laptop and tablet worlds, the Surface Pro 3 is the device to buy. It has a beautiful high-res screen, an innovative stylus and the ability to run proper Windows applications. It's expensive, but this piece of kit can do it all.

PROCESSOR Dual-core 1.9GHz Intel Core i5-4300U • SCREEN SIZE 12in • SCREEN RESOLUTION 2,160x1,440 • REAR CAMERA 5 megapixels • STORAGE 128GB • WIRELESS DATA None • DIMENSIONS 292x201x9mm • WEIGHT 800g • OPERATING SYSTEM Windows 8.1 Pro • WARRANTY One year RTB • PART CODE Surface Pro 3 • DETAILS www.microsoft.com • FULL REVIEW Nov 2014



TESCO Hudl 2

★★★★★

£129 inc VAT • www.tesco.com/direct/hudl

The Hudl 2 is even better value than the original. It has a great screen, good build quality and runs Android smoothly. Battery life isn't great, but otherwise this is a fantastic complete budget tablet.

PROCESSOR Quad-core 1.33GHz Intel Atom Z3750 • SCREEN SIZE 8.3in • SCREEN RESOLUTION 1,920x1,200 • REAR CAMERA 5 megapixels • STORAGE 16GB • WIRELESS DATA None • DIMENSIONS 224x128x9mm • WEIGHT 410g • OPERATING SYSTEM Android 4.4.2 • WARRANTY One year RTB • PART CODE hudl2 • DETAILS www.tesco.com/direct/hudl • FULL REVIEW Jan 2015



Choosing a ... Monitor

01 A basic 24in LCD monitor costs around £100. It will be fine for typical Windows work but is likely to have poor viewing angles, so you'll need to sit straight on to achieve the best picture quality. Its colour accuracy may not be very good, either.

02 A VGA input lets you use the monitor with any PC, but the quality may not be as good as it is over DVI or HDMI. Both are digital connections and require a compatible graphics card but they avoid the need for digital-to-analogue or analogue-to-digital conversions, which can reduce image quality. A digital connection achieves the best picture automatically, so you won't have to adjust clock or phase settings as you do with analogue connections.

Many DVI and all HDMI connections support HDCP, which lets you watch protected video content, such as Blu-ray movies. DisplayPort is becoming more popular, but you'll need a DisplayPort output (mini or full-size) on your PC or laptop to use this input on your monitor.

03 A larger monitor will be easier on the eye and may have a higher resolution. Most monitors have resolutions of at least 1,920x1,080 (1080p), which provide lots of room for working with multiple windows at the same time. For even higher resolutions, you'll need a larger display.

Some 27in and 30in screens have 2,560x1,600 or even 4K resolutions. You'll need a graphics card with a dual-link DVI output and a dual-link DVI cable or either HDMI or DisplayPort to use a monitor at these resolutions.

04 If you want better picture quality, look for a monitor with a high contrast ratio. The higher the ratio, the whiter the whites and the blacker the blacks. You'll also see more fine detail in images with high contrast levels.

Viewing angles are important, as wider angles mean you don't have to sit directly in front of the monitor to get the best picture. Wider viewing angles also allow more people to view the screen at the same time.

Fast response times reduce ghosting, but don't be dazzled by the numbers. A response time of 25ms or quicker is fine for all applications.

PHOTOGRAPHY

COMPACT SYSTEM CAMERA	COMPUTER SHOPPER SAMSUNG NX3000 RECOMMENDED ★★★★★ £199 inc VAT • www.currys.co.uk With its high image quality, wealth of features and slim design, the NX3000 is an excellent camera. Better still, at its current low price it's an unbelievable bargain. Buy one while you can. SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 23.5x15.7mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER None • LCD SCREEN 3in (460,800 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3.1x (24-75mm) • 35mm-EQUIVALENT APERTURE f/5.2-8.4 • LENS MOUNT Samsung NX • WEIGHT 386g • DIMENSIONS 67x126x78mm • WARRANTY One year RTB • DETAILS www.samsung.com/uk • FULL REVIEW Jan 2015	
COMPACT CAMERA	COMPUTER SHOPPER NIKON Coolpix S9700 BEST BUY ★★★★★ £165 inc VAT • www.johnlewis.com This compact camera packs in a 30x zoom lens, Wi-Fi, GPS and slow-motion video. Its has a comprehensive set of controls, but it's the image quality that really impresses, achieving decent shots in tough conditions. SENSOR RESOLUTION 16 megapixels • SENSOR SIZE 1/2.3in • VIEWFINDER None • LCD SCREEN 3in (921,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 30x (25-750mm) • 35mm-EQUIVALENT APERTURE f/21-36 • WEIGHT 235g • DIMENSIONS 66x110x34mm • WARRANTY Two years RTB • DETAILS www.nikon.co.uk • FULL REVIEW Nov 2014	
ULTRA-ZOOM CAMERA	COMPUTER SHOPPER PANASONIC Lumix DMC-FZ200 BEST BUY ★★★★★ £329 inc VAT • www.johnlewis.com This ultra-zoom camera has a big 25-600mm zoom range and maintains a fast F2.8 aperture across the whole focal range, so you can shoot in low-light conditions without too much worry. SENSOR RESOLUTION 12.1 megapixels • SENSOR SIZE 6.2x4.6mm (1/2.3in) • VIEWFINDER Electronic • LCD SCREEN 3in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 24x (25-600mm) • 35mm-EQUIVALENT APERTURE f/15.5 • WEIGHT 588g • DIMENSIONS 87x125x110mm • WARRANTY One year RTB • DETAILS www.panasonic.com/uk • FULL REVIEW Feb 2013	
SLR CAMERA	COMPUTER SHOPPER NIKON D7100 BEST BUY ★★★★★ £899 inc VAT • www.wexphotographic.com The Nikon D7100 provides class-leading image quality, exceptional ergonomics and a sophisticated autofocus system. If you love photography, you'll love the Nikon D7100. This kit comes with the 18-105mm VR lens. SENSOR RESOLUTION 24 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.52x • VIEWFINDER Optical • LCD SCREEN 3.2in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 27-157mm • 35mm-EQUIVALENT APERTURE N/A • LENS MOUNT F-mount • WEIGHT 1.2kg • DIMENSIONS 108x137x160mm • WARRANTY Two years RTB • DETAILS www.nikon.co.uk • FULL REVIEW Oct 2013	
SLR CAMERA	COMPUTER SHOPPER CANON EOS 700D BEST BUY ★★★★★ £499 inc VAT • www.wexphotographic.com This superb all-rounder avoids the flaws of its predecessors. Photos taken with its 18-55mm kit lens were consistently better than those of similarly priced cameras, and there's a wide range of affordable extra lenses. SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 22.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.62x • VIEWFINDER Optical • LCD SCREEN 3in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 27-82.5mm (kit lens) • 35mm-EQUIVALENT APERTURE N/A • LENS MOUNT EF-mount • WEIGHT 755g (body only) • DIMENSIONS 104x139x79mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW Nov 2013	

DISPLAYS

MONITOR	COMPUTER SHOPPER BENQ GW2765HT BEST BUY ★★★★★ £286 inc VAT • www.laptopsdirect.co.uk This 27in 2,560x1,440 IPS monitor is one of the best-value screens we've ever seen. With near-perfect sRGB colour accuracy out of the box, it's a steal for less than £300. SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, DisplayPort • WARRANTY Two years onsite • PART CODE G72765HT • DETAILS www.benq.com • FULL REVIEW Jan 2015	
MONITOR	COMPUTER SHOPPER VIEWSONIC VX2363Smhl-W RECOMMENDED ★★★★★ £113 inc VAT • www.ebuyer.com The 23in VX2363Smhl-W stands out from the crowd with its white stand, IPS screen and great overall image quality. It's a good budget buy for those who have modest needs. SCREEN SIZE 23in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, 1x HDMI, 1x MHL-compatible HDMI • WARRANTY Two years collect and return • PART CODE VX2363Smhl-W • DETAILS www.viewsoniceurope.com • FULL REVIEW Jan 2015	
MONITOR	COMPUTER SHOPPER IYYAMA ProLite GB2488HSU-B1 BEST BUY ★★★★★ £204 inc VAT • www.scan.co.uk Gamers need look no further than the Iiyama ProLite GB2488HSU-B1. It's a no-nonsense Full HD panel with a 144Hz refresh rate for lightning-fast games. This display is great value. SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY TN • VIDEO INPUTS 2x HDMI, DVI, DisplayPort • WARRANTY Two years onsite • PART CODE ProLite GB2488HSU-B1 • DETAILS www.iiyama.com • FULL REVIEW Aug 2014	
MONITOR	COMPUTER SHOPPER ASUS PB279Q BEST BUY ★★★★★ £598 inc VAT • www.ballicom.co.uk If you're remotely serious about design, photography or gaming and want an Ultra HD screen, this is the monitor to choose. It's plain to look at and has no USB hub, but in terms of pure image quality, nothing beats it at this price. SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY AHVA • REFRESH RATE 60Hz • VIDEO INPUTS 4x HDMI, DisplayPort, Mini DisplayPort • WARRANTY Three years RTB • DETAILS www.asus.com • FULL REVIEW Apr 2015	
MONITOR	COMPUTER SHOPPER SAMSUNG S32D850T BEST BUY ★★★★★ £435 inc VAT • www.laptopsdirect.co.uk It's not cheap, but this 32in monitor is great value. Images are sharp and vibrant on its 2,560x1,440 panel, and the stand is among the most attractive we've seen. SCREEN SIZE 32in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY VA • VIDEO INPUTS HDMI, DVI, DisplayPort • WARRANTY Two years collect and return • PART CODE S32D850T • DETAILS www.samsung.com/uk • FULL REVIEW Jan 2015	

Choosing a ...

Bluetooth speaker

01 Bluetooth speakers come in all shapes and sizes, so it's worth deciding what you want to do with it before you buy. If you don't plan to take your music outdoors or around the house, look for a wired speaker. These are typically cheaper than speakers with built-in batteries. If you do want a portable speaker, however, pay particular attention to how much it weighs. Ruggedised models should be able to survive accidental drops, water spills and unexpected rain showers.

02 Many of the cheapest Bluetooth speakers use the lossy A2DP Bluetooth protocol, which is prone to compressing your music and discarding detail compared with the original recording.

It's hard to tell the difference when listening to pocket-sized speakers, but if you're looking for a speaker to fill a room, an aptX-compatible device is a better option. This Bluetooth protocol retains more detail than A2DP, although you'll need to use it with a compatible smartphone to get the benefits.

03 As with any audio product, the number and size of speaker drivers can have a significant impact on the quality of sound you get from a Bluetooth speaker. Typically, the presence of multiple drivers enables the manufacturer to tune each one for specific frequencies, directing high-end sounds towards a tweeter and sending the mid-range frequencies to the main driver. Single-driver speakers with larger driver cones can be just as capable of producing fantastic audio, however.

04 Most Bluetooth speakers have at least one auxiliary input for a wired 3.5mm audio jack, in case you want to listen to music from a device that doesn't have Bluetooth. There are other extra features to look out for, though. Speakers with built-in batteries may have a USB port for charging your smartphone, or a built-in microphone to turn it into a speakerphone when a paired smartphone receives a call. Not all speakers have physical controls – many rely on your paired device's controls for adjusting the volume or muting playback.

HOME CINEMA

COMPUTER SHOPPER LG 47LB730V

BEST BUY ★★★★★

£569 inc VAT • www.hillsradio.co.uk

The LG 47LB730V has one of the best screens and smart TV interfaces we've seen. With its fantastic design and great picture quality straight out of the box, the 47LB730V is great value.

SCREEN SIZE 47in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER FreeviewHD • DIMENSIONS 1,061x666x227mm • WARRANTY Five years RTB • DETAILS www.lg.com/uk • PART CODE 47LB730V • FULL REVIEW Mar 2015



COMPUTER SHOPPER SAMSUNG UE40H5500

BEST BUY ★★★★★

£369 inc VAT • www.richersounds.co.uk

This is an excellent mid-range TV with brilliant 3D performance, great all-round picture quality and unparalleled online content. It's also available in models from 32in right up to 75in, making it the perfect fit for any room size.

SCREEN SIZE 40in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 906x578x196mm • WARRANTY Five years RTB • DETAILS www.samsung.com/uk • PART CODE UE40H5500 • FULL REVIEW May 2015



COMPUTER SHOPPER OPTOMA HD151X

BEST BUY ★★★★★

£669 inc VAT • www.richersounds.co.uk

A great-value 3D projector that delivers fantastic image quality in all lighting conditions. Its large amount of lens shift makes it easy to set up and its optional wireless support gives it even more flexibility.

PROJECTOR TYPE DLP • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS HDMI, DVI-D, VGA x2, S-video, composite • LAMP LIFE 4,000h • LAMP BRIGHTNESS 2,800 Lumens • SIZE 162x386x280mm • WEIGHT 4.5kg • WARRANTY One year RTB • DETAILS www.optoma.co.uk • PART CODE HD151X • FULL REVIEW Mar 2015



COMPUTER SHOPPER SAMSUNG BD-H6500

BEST BUY ★★★★★

£107 inc VAT • www.ebuyer.com

This 3D-capable Blu-ray player produces a great picture, offers an excellent range of Smart TV services and provides the best DVD upscaling we've seen at this price.

BLU-RAY PROFILE BD-Live (Profile 5) • HDMI VERSION 1.4 • 3D CAPABLE Yes • NETWORKING 1x 10/100, 802.11n • WARRANTY One year RTB • PART CODE BD-H6500 • DETAILS www.samsung.com/uk • FULL REVIEW Oct 2014



COMPUTER SHOPPER LG NB3540

RECOMMENDED ★★★★★

£220 inc VAT • www.currys.co.uk

The NB3540 may not have many ports, but this simple 2.1-channel soundbar and wireless subwoofer is incredibly stylish and produces fantastic sound for the price.

SPEAKERS 2 • RMS POWER OUTPUT 160W • DIMENSIONS 770x75x35mm (soundbar), 196x297x390mm (subwoofer) • WEIGHT 1.3kg • DOCK CONNECTOR N/A • NETWORKING Bluetooth 3.0 • WARRANTY One year RTB • PART CODE NB3540 • DETAILS www.lg.com/uk • FULL REVIEW Dec 2014



AUDIO

COMPUTER SHOPPER PHILIPS Fidelio M2BT

BEST BUY ★★★★★

£176 inc VAT • www.amazon.co.uk

The Philips Fidelio M2BT are premium Bluetooth headphones that sound great, look fantastic and are supremely comfortable.

HEADPHONES TYPE On-ear Bluetooth • PLUG TYPE 3.5mm jack plug • WEIGHT 190g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS www.philips.co.uk • PART CODE M2BTBK/00 • FULL REVIEW Apr 2015



COMPUTER SHOPPER BLUESOUND Pulse

RECOMMENDED ★★★★★

£599 inc VAT • www.sevenoakssoundandvision.co.uk

The audiophile's choice for multiroom audio. The Bluesound Pulse has excellent sound quality, support for high-resolution audio and is compatible with plenty of music-streaming services.

SPEAKERS 5 • RMS POWER OUTPUT 80W • DOCK CONNECTOR None • WIRELESS 802.11n Wi-Fi, 10/100 Ethernet, optional Bluetooth (SBC) • DIMENSIONS 420x190x197mm • WEIGHT 6.1kg • WARRANTY One year RTB • DETAILS www.bluesound.com • FULL REVIEW Mar 2015



COMPUTER SHOPPER CAMBRIDGE AUDIO G2

BEST BUY ★★★★★

£80 inc VAT • www.richersounds.com

The Cambridge Audio G2 has excellent sound quality for a portable Bluetooth speaker and very respectable battery life.

SPEAKERS 2 • RMS POWER OUTPUT Not disclosed • DOCK CONNECTOR None • WIRELESS Bluetooth (SBC) • DIMENSIONS 189x55x67mm • WEIGHT 650g • WARRANTY One year RTB • DETAILS www.cambridgeaudio.com • PART CODE G2 Mini Portable Bluetooth Speaker • FULL REVIEW Mar 2015



COMPUTER SHOPPER APPLE iPod Touch

BEST BUY ★★★★★

£199 inc VAT • store.apple.com/uk

The fifth iPod Touch is the best device of its kind. Its battery lasts for three days of continuous music playback or eight hours of video. Its display is great and its audio is as reliable as ever, though format support is limited.

CAPACITY (FORMATTED) 32GB • DISPLAY 4in colour LCD touchscreen • SUPPLIED HEADPHONES Earphones • SUPPORTED AUDIO FORMATS AAC, MP3, AIFF, WAV, Audible • WARRANTY One year RTB • PART CODE MD723B1/A • DETAILS www.apple.com/uk • FULL REVIEW Feb 2013



COMPUTER SHOPPER ARCAM miniBlink

RECOMMENDED ★★★★★

£90 inc VAT • www.petertyson.co.uk

Stream music from your mobile phone or tablet to your hi-fi with the petite and attractive miniBlink. This high-quality Bluetooth receiver sounds good and is delightfully simple to use.

WARRANTY Two years RTB • PART CODE miniBlink • DETAILS www.arcam.co.uk • FULL REVIEW Aug 2014



SMART TV

SMART TV

PROJECTOR

BLU-RAY PLAYER

SOUNDBAR

ON-EAR HEADPHONES

PORTABLE SPEAKER

PORTABLE SPEAKER

MEDIA PLAYER

AUDIO INTERFACE

Choosing an ...

Internal hard disk

01 A basic 1TB internal hard disk should cost around £40. It will be fast enough for general use and provide enough storage for most users.

Make sure the hard disk you choose has the appropriate interface type for your PC. Some mechanical hard disks still come with SATA2 interfaces, but newer models and most solid-state drives (SSDs) have faster SATA3 interfaces. You'll need a motherboard with a SATA3 port if you want to benefit from SATA3's faster speeds – SATA3 disks will work with SATA2 ports but can only transfer files at SATA2 speeds.

02 SSDs can make the most of SATA3's extra bandwidth for fast file transfers. They use flash memory similar to that found in USB flash drives, and although they tend to provide less capacity than mechanical hard disks, they're significantly faster.

03 Buy a hard disk that provides more capacity than you think you need, as your storage requirements are likely to grow. A 2TB disk strikes the best balance between capacity and low cost per gigabyte, but in general you should aim to buy the largest disk you can afford.

04 If you want more disk space or you want to protect your data against disk failure, think about buying several hard disks to create a RAID array. These use multiple hard disks to create one large logical disk with better performance, or to duplicate your data for better protection.

RAID arrays require hard disks of the same size. In theory, they can be from different manufacturers, but it's better to buy identical disks if you can.

05 A hard disk's spindle speed determines how quickly it can transfer data. A spindle speed of 7,200rpm is common in desktop drives and is fast enough for most purposes. Desktop hard disks with 5,400rpm spindle speeds are quite slow but use less power and generate less heat and noise.

To strike the best balance between speed and storage capacity, use an SSD as your system disk and store your files on a larger mechanical disk.

STORAGE

SSD	COMPUTER SHOPPER BEST BUY CRUCIAL M550 1TB ★★★★★ £342 inc VAT • www.pcupgrade.co.uk This SSD has a massive 1TB capacity, and while it isn't cheap it's certainly great value. The M550 has fantastic performance, too, making it an excellent buy. CAPACITY 1TB • COST PER GIGABYTE £0.34 • INTERFACE SATA3 • WARRANTY Three years RTB • DETAILS www.crucial.com/uk • PART CODE CT1024M550SSD1 • FULL REVIEW Apr 2015	
HARD DISK	COMPUTER SHOPPER BEST BUY WESTERN DIGITAL Red 6TB ★★★★★ £219 inc VAT • www.dabs.com The Red 6TB combines excellent performance with a high capacity and special firmware, making a hard disk that's perfect for use in NAS enclosures. CAPACITY 6TB • COST PER GIGABYTE £0.04 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE WD60EFRX • DETAILS www.wdc.com • FULL REVIEW Nov 2014	
EXTERNAL HARD DISK	COMPUTER SHOPPER RECOMMENDED G-TECHNOLOGY G-RAID Studio 8TB ★★★★☆ £599 inc VAT • store.apple.com/uk External storage doesn't get faster than this. The two 4TB hard disks in a RAID 0 array are even quick enough to edit 4K video, although you'll need a Thunderbolt port to plug it into. CAPACITY 8TB • COST PER GIGABYTE £0.07 • INTERFACE Thunderbolt • WARRANTY One year RTB • DETAILS www.g-technology.com • PART CODE 0G03366 • FULL REVIEW Mar 2015	
PORTABLE SSD	COMPUTER SHOPPER BEST BUY SAMSUNG T1 500GB ★★★★★ £217 inc VAT • www.scan.co.uk The T1 is significantly faster than any USB3 flash drive as it has its own SD controller. Combined with a USB3 connection, it's able to transfer files at unbelievable speeds – then slips into a pocket for taking on the move. CAPACITY 500GB • COST PER GIGABYTE £0.45 • INTERFACE USB3 • CLAIMED READ 450MB/s • CLAIMED WRITE 450MB/s • WARRANTY Three years RTB • DETAILS www.samsung.com/uk • PART CODE MU-PS500B/EU • FULL REVIEW Apr 2015	
PORTABLE HARD DISK	COMPUTER SHOPPER BEST BUY WESTERN DIGITAL My Passport Ultra 1TB ★★★★★ £60 inc VAT • www.pcworld.co.uk This compact 5,400rpm USB3 external hard disk comes with excellent backup and encryption software. We reviewed the 1TB model, which is a bargain, but for an extra £25 you can pick up the 2TB version. CAPACITY 1TB • COST PER GIGABYTE £0.06 • SPINDLE SPEED 5,400rpm • INTERFACES USB3 • DIMENSIONS 15x8x211mm • WARRANTY Three years RTB • PART CODE WDBZFP0010BKK • DETAILS www.wdc.com • FULL REVIEW Sep 2013	

PRINTERS AND SCANNERS

MONO LASER PRINTER	COMPUTER SHOPPER BUSINESS BUY XEROX Phaser 3610 ★★★★☆ £299 inc VAT • www.printerland.co.uk The Phaser 3610 is a mono laser printer for small firms and workgroups. It's fast, reaching 47ppm in our tests, and has a claimed monthly duty cycle of up to 110,000 pages. Best of all, at 1.1p per page it's cheap to run. TECHNOLOGY Mono laser • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS 315x395x426mm • WEIGHT 13kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • PART CODE 3610V_DN • DETAILS www.xerox.co.uk • FULL REVIEW Jan 2014	
COLOUR LASER	COMPUTER SHOPPER BEST BUY CANON i-SENSYS LBP7780Cx ★★★★★ £403 inc VAT • www.lambda-tek.com It's somewhat expensive to buy, but the Canon i-SENSYS LBP7780Cx is very cheap to run and produces impressively high-quality prints. TECHNOLOGY Single-pass colour laser • MAXIMUM PRINT RESOLUTION 600x600dpi • DIMENSIONS 401x517x530mm • WEIGHT 31kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS www.canon.co.uk • PART CODE 6140B010AA • FULL REVIEW Mar 2015	
INKJET MFP	COMPUTER SHOPPER BEST BUY EPSON Expression Photo XP-760 ★★★★★ £120 inc VAT • www.amazon.co.uk It's not brilliant for printing office documents, but if you want great photos and brilliant scanning, Epson's good-looking and compact XP-760 is perfect. TECHNOLOGY Piezo inkjet • MAXIMUM PRINT RESOLUTION 5,760x1,440dpi • MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH) 2,400x4,800dpi (48-bit) • DIMENSIONS 141x290x341mm • WEIGHT 6.9kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.epson.co.uk • PART CODE C11CD96401 • FULL REVIEW Mar 2015	
INKJET MFP	COMPUTER SHOPPER BEST BUY CANON Pixma MG5650 ★★★★★ £71 inc VAT • www.printerland.co.uk This multifunction peripheral provides duplex printing and Wi-Fi, as well as good-quality scans, prints and copies, and at 7.3p per page its running costs are fairly low. It's an excellent general-purpose MFP. TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 148x455x369mm • WEIGHT 6.3kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • PART CODE 9487B008AA • DETAILS www.canon.co.uk • FULL REVIEW Dec 2014	
OFFICE PRINTER	COMPUTER SHOPPER BEST BUY HP Officejet Pro X476dw ★★★★★ £330 inc VAT • www.ebuyer.com It may be an inkjet, but HP's MFP beats many colour lasers in terms of speed, print quality and running costs. TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 2,400x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 517x517x399mm • WEIGHT 24kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS www.hp.co.uk • PART CODE CN461A • FULL REVIEW Mar 2015	

NETWORKS

PORTABLE 3G ROUTER

COMPUTER SHOPPER
RECOMMENDED

TP-LINK M5350

★★★★★

£40 inc VAT • www.currys.co.uk

The M5350 is a bargain portable 3G router that's easy to set up and use. Its screen could be bigger, but the icons are clearly displayed. It's great for making the most of your data SIM.

MODEM 3G • WI-FI STANDARD 802.11n • USB PORTS None • WALL MOUNTABLE? No • WARRANTY Three years RTB • PART CODE M5350 • DETAILS uk.tp-link.com • FULL REVIEW Dec 2014



MODEM ROUTER

COMPUTER SHOPPER
BEST BUY

ASUS DSL-AC68U

★★★★★

£180 inc VAT • www.peworld.co.uk

The DSL-AC68U combines high-speed performance with the ability to use a 3G or 4G modem, operate as a NAS and share a USB printer.

MODEM ADSL2+/VDSL2 • WI-FI STANDARD 802.11ac • STATED SPEED 1,300Mbit/s • USB PORTS 1x USB3 • WARRANTY Three years RTB • PART CODE DSL-AC68U • DETAILS www.asus.com • FULL REVIEW Jan 2015



WI-FI RANGE EXTENDER

COMPUTER SHOPPER
RECOMMENDED

NETGEAR AC750-Wi-Fi Range Extender

★★★★★

£64 inc VAT • www.dabs.com

This Wi-Fi extender helps liven up the Wi-Fi deadzones in your home or office. It works on both the 2.4GHz and 5GHz bands simultaneously, and it even has an Ethernet port that's ideal for connecting devices such as games consoles and smart TVs.

WARRANTY Two years RTB • DETAILS www.netgear.co.uk • PART CODE EX6100-100UKS • FULL REVIEW Nov 2014



POWERLINE KIT

COMPUTER SHOPPER
RECOMMENDED

DEVOLO dLAN 1200+ Starter Kit

★★★★★

£160 inc VAT • www.dabs.com

Devol's dLAN 1200+ is the fastest Powerline networking kit we've seen, even if you're limited to a single Gigabit Ethernet connection. The passthrough sockets are very convenient too.

POWERLINE NETWORKING STANDARD HomePlug • STATED SPEED 1,200Mbit/s • ADAPTORS IN BOX 2 • WARRANTY Three years RTB • PART CODE 09378 • DETAILS www.devolo.com/uk • PART CODE 09378 • FULL REVIEW Feb 2015



WIRELESS ROUTER

COMPUTER SHOPPER
BEST BUY

LINKSYS WRT1900AC

★★★★★

£200 inc VAT • www.dabs.com

The WRT1900AC's Wi-Fi performance is superb whether you're using 802.11ac or 802.11n equipment, and its many features make it a must-buy for those who like to tinker.

MODEM None • WI-FI STANDARD 802.11ac • STATED SPEED 1,300Mbit/s • USB PORTS 2 • WALL MOUNTABLE Yes • WARRANTY Two years RTB • PART CODE WRT1900AC • DETAILS www.linksys.com • FULL REVIEW Aug 2014



VIDEO

SMART TV ADAPTOR

COMPUTER SHOPPER
RECOMMENDED

AMAZON Fire TV

★★★★★

£79 inc VAT • www.amazon.co.uk

Fire TV provides access to Amazon's Instant Video service, as well as on-demand services such as BBC iPlayer. You also get access to apps and games from Amazon's App Store, which can take advantage of the optional Amazon Fire TV game controller, making the Fire TV a simple games console.

VIDEO OUTPUTS HDMI • NETWORKING 802.11n (dual band) • DIMENSIONS 78x28x12mm • STREAMING FORMATS UPnP, AirPlay, DLNA • INTERNET STREAMING SERVICES iPlayer, Netflix, Sky News, Spotify, TuneIn Radio, Amazon Instant Video, TVPlayer • WARRANTY One year RTB • PART CODE Fire TV • DETAILS www.amazon.co.uk • FULL REVIEW Dec 2014



ACTION CAM

COMPUTER SHOPPER
RECOMMENDED

GOPRO Hero4 Black

★★★★★

£359 inc VAT • www.amazon.co.uk

The GoPro Hero4 Black doesn't deviate from the existing GoPro template but is an excellent action camera that introduces stunning 4K video at 30fps. You also get support for a wide range of mounts and accessories, meaning you'll be able to capture fantastic footage whatever the activity.

SENSOR 1/2.3in CMOS • SENSOR PIXELS 12,000,000 • MAX RECORDING RESOLUTION 4K (30fps) • AV CONNECTIONS Micro HDMI output, 3.5mm microphone to Mini USB (optional) • DIMENSIONS 41x59x30mm • WEIGHT 89g (52g with housing) • WARRANTY One year RTB • DETAILS www.gopro.com • PART CODE CHDHX-4-1-EU • FULL REVIEW May 2015



CAMCORDER

COMPUTER SHOPPER
BEST BUY

CANON Legria HF G30

★★★★★

£930 inc VAT • www.johnlewis.com

This fantastic enthusiast camcorder has a capacitive touchscreen monitor, a great electronic viewfinder and a sensible array of function buttons. Its image quality is excellent, too.

OPTICAL ZOOM 20x • SENSOR 1/2.3in CMOS • LCD SCREEN 3.7in LCD, 1,230,000 dots • DIMENSIONS 84x89x182mm • WEIGHT 900g • WARRANTY One year RTB • PART CODE 8454B009AA • DETAILS www.canon.co.uk • FULL REVIEW Sep 2013



GAMEPLAY RECORDER

COMPUTER SHOPPER
RECOMMENDED

HAUPPAUGE HD PVR Rocket

★★★★★

£89 inc VAT • www.ebuyer.com

The HD PVR Rocket lets you record your gameplay from a PC or games console, including your own commentary. It's well designed, with a large red Record button and the ability to record directly to a USB drive.

WARRANTY Two years RTB • PART CODE 1527 • DETAILS www.hauppage.co.uk • FULL REVIEW Apr 2013



CAMCORDER

COMPUTER SHOPPER
BEST BUY

PANASONIC HC-X920

★★★★★

£690 inc VAT • www.purewell.co.uk

This camcorder uses three 1/2.3in BSI MOS sensors to record Full HD video with excellent colour reproduction and tremendous detail. Its built-in Wi-Fi adaptor lets you connect to a smartphone or stream video over your network.

OPTICAL ZOOM 12x • SENSOR 3x 1/2.3in BSI MOS • LCD SCREEN 3.7in LCD, 1,152,000 dots • DIMENSIONS 72x67x150mm • WEIGHT 417g • WARRANTY One year RTB • PART CODE HC-X920EB-K • DETAILS www.panasonic.co.uk • FULL REVIEW May 2013



Choosing a ...

NAS device

01 A network-attached storage (NAS) device lets you store media, documents and other files on its hard disks so that you can share them with others on your network. Some have disks already installed, while others are empty enclosures into which you install your own disks.

You should buy one with a Gigabit Ethernet interface, as these provide the highest transfer speeds. To use a NAS device at these speeds, you'll need computers with Gigabit Ethernet network adaptors and a Gigabit Ethernet switch or router. Computers with Fast Ethernet (10/100) adaptors will still be able to access the NAS device, but only at speeds of up to 100Mbit/s.

02 The amount of network storage you need depends on the types of files you use. If you want to store Word and Excel documents, for example, a 1TB device will be more than enough. In fact, a 1TB device should be sufficient for a family's entire media collection. Small businesses should consider higher storage capacities, depending on the nature of the business.

03 If you can see no end to your storage needs, buy an upgradable NAS device. Many have a USB port for adding an external disk. Devices such as Synology's barebones NAS kits have spare disk trays for cheaper and faster upgrades.

04 If you want extra protection for your important data, look for a device that supports RAID. RAID 1 and RAID 5 arrays reduce the available capacity by duplicating data, but you won't lose it if a disk fails.

05 If you need access to your files while you're away from home or the office, look for a NAS device with an FTP server. Some models can also share a USB printer across your network, saving you the expense of buying an Ethernet printer.

A NAS device with a Universal Plug and Play (UPnP) media server can stream your music, photos and videos to a network media player, so you will be able to enjoy your media collection in another room.

Choosing a ... Graphics card

01 You really don't have to spend much to buy a decent graphics card that can drive multiple monitors. The AMD Radeon R7 250 costs less than £60, for example, and while it isn't suited to playing the latest games in Full HD, it is perfect for watching videos, browsing the web and playing basic games.

02 You'll need to spend more money if you want to play the latest games, though. A good mid-range gaming graphics card is the AMD R9 270X, which is powerful enough to play any current title. High-powered cards tend to be more expensive, so expect to pay over £300 if you want to play games in Ultra HD at the highest quality settings.

03 Check that your chosen card has the graphics outputs you need. Only low-end cards now have VGA outputs, but many come with a DVI-to-VGA adaptor. Depending on your monitor, you may also want an HDMI output or even a DisplayPort connection.

Bear in mind that AMD's Eyefinity triple-monitor gaming mode requires at least one DisplayPort monitor, which means your AMD graphics card must have at least one DisplayPort output. Nvidia's Surround three-monitor mode needs only DVI and HDMI ports.

04 The amount of memory a card has is important if you want games to look their best at high resolutions. Get a card with 2GB of RAM at the very least, as this should allow you to select the highest-quality textures in games.






05 A card's size, noise output and power requirements are the final considerations. Make sure your PC's case has enough room to accommodate your chosen card. Double-slot cards with large fans tend to be quieter than single-slot cards with small fans but will block other expansion slots on your motherboard.

Also check that your power supply can provide the power the card needs and that it has the right connectors. Many cards require a six-pin PCI Express power connector, and some also need an additional eight-pin connector.

COMPONENTS

GRAPHICS CARD	COMPUTER SHOPPER RECOMMENDED	XFx Radeon R9 290 Black Double Dissipation Edition	
	★★★★★	£218 inc VAT • www.ebuyer.com The R9 290 does most of what the top-end R9 290X can do but at a lower price, and neatly undercuts Nvidia's GeForce GTX 970, making it the obvious choice for 1440p gaming. GPU AMD Radeon R9 290 • MEMORY 4GB GDDR5 • CARD LENGTH 283mm • WARRANTY Two years RTB • DETAILS www.xfxforce.com • PART CODE R9-290A-ED8D • FULL REVIEW May 2015	
PROCESSOR	COMPUTER SHOPPER BEST BUY	INTEL Core i5-4690K	
	★★★★★	£189 inc VAT • www.scan.co.uk The Core i5-4690K is a redesigned variant of the Core i5-4670K and runs at a faster speed out of the box but at lower temperatures. Coupled with its unlocked multiplier, this means the chip is ideal for overclocking. SOCKET LGA1150 • CORES 4 • FREQUENCY 3.5GHz • INTEGRATED GRAPHICS Intel HD Graphics 4600 • WARRANTY One year RTB • DETAILS www.intel.com • PART CODE BX80646I54690K • FULL REVIEW May 2015	
PROCESSOR	COMPUTER SHOPPER BEST BUY	AMD A10-7700K	
	★★★★★	£92 inc VAT • www.ebuyer.com The A10-7700K is strikes an excellent balance between desktop and graphics performance, making it the ideal all-rounder for an inexpensive PC build. SOCKET FM2 • CORES 4 • FREQUENCY 3.4GHz • INTEGRATED GRAPHICS AMD Radeon R7 • WARRANTY One year RTB • DETAILS www.amd.com • PART CODE AD770KXBJABOX • FULL REVIEW May 2015	
MOTHERBOARD	COMPUTER SHOPPER RECOMMENDED	ASUS Z97-E	
	★★★★★	£104 inc VAT • www.dabs.com The Asus Z97-E is well priced for an LGA1150 motherboard, and automatic overclocking helps squeeze extra performance from your CPU with minimal effort. SOCKET LGA1150 • CHIPSET Intel Z97 • MEMORY SLOTS 4 • PCI-E x16 SLOTS 2 • PCI-E x1 SLOTS 3 • PCI SLOTS 2 • USB PORTS 2x USB3, 4x USB2 • VIDEO OUTPUTS HDMI, DVI, VGA • DIMENSIONS 305x218mm • WARRANTY Three years RTB • DETAILS www.asus.com • PART CODE Z97-E • FULL REVIEW May 2015	
PC CASE	COMPUTER SHOPPER RECOMMENDED	SILVERSTONE Quiet Precision PS11	
	★★★★★	£35 inc VAT • www.scan.co.uk Well made and finished for the price, with plenty of sound-deadening features, the PS11 is the ideal starting point for a new PC build. The design might be a little plain, but we aren't complaining for £35. CASE TYPE ATX • MOTHERBOARD COMPATIBILITY ATX, microATX, Mini-ITX • SUPPLIED FANS 1x 120mm • MAX 3 1/2in DRIVE BAYS 3 • MAX 5 1/2in DRIVE BAYS 2 • DIMENSIONS 215x482x427mm • WEIGHT 4.8kg • WARRANTY One year RTB • DETAILS www.silverstonetek.com • PART CODE SST-PS11B-Q • FULL REVIEW May 2015	

SOFTWARE

VIDEO EDITING	COMPUTER SHOPPER BEST BUY	ADOBE Premiere Elements 13	
	★★★★★	£60 inc VAT • www.johnlewis.com Premiere Elements 13 offers a wealth of features to keep advanced video editors happy and has even more to help new users make the most of it. It's the best consumer video-editing package you can buy. OS SUPPORT Windows 7, 8 • MINIMUM CPU 2GHz with SSE2 • MINIMUM GPU DirectX 9 or 10 • MINIMUM RAM 2GB • HARD DISK SPACE 5GB • DETAILS www.adobe.com/uk • PRODUCT CODE 65234288 • FULL REVIEW Jan 2015	
DESKTOP PUBLISHING	COMPUTER SHOPPER BEST BUY	SERIF PagePlus X8	
	★★★★★	£90 inc VAT • www.serif.com Get full control over the layout and appearance of your documents, from flyers to professional-looking publications. Version 8 adds a baseline grid, making text easier to line up, and improves photo editing. OS SUPPORT Windows XP or later • MINIMUM CPU Intel Pentium 4 or later, AMD Athlon 64 or later • MINIMUM GPU Not stated • MINIMUM RAM 512MB (Windows XP), 1GB (Vista, 32-bit Windows 7/8), 2GB (64-bit Windows 7/8) • HARD DISK SPACE 510MB • DETAILS www.serif.com/pageplus • PRODUCT CODE N/A • FULL REVIEW Feb 2015	
PHOTO EDITING	COMPUTER SHOPPER RECOMMENDED	ADOBE Photoshop Elements 13	
	★★★★★	£60 inc VAT • www.johnlewis.com Elements may not have all the features of the full version of Photoshop, but it's still our favourite photo-editing package, and version 13 is the best yet, thanks to a new Guided mode for newcomers. OS SUPPORT Windows 7, 8 • MINIMUM CPU 1.6GHz with SSE2 • MINIMUM GPU DirectX 9 or 10 • MINIMUM RAM 2GB • HARD DISK SPACE 5GB • DETAILS www.adobe.com/uk • PRODUCT CODE 65237742 • FULL REVIEW Feb 2015	
GRAPHIC DESIGN	COMPUTER SHOPPER BEST BUY	SERIF Affinity Designer	
	★★★★★	£40 inc VAT • affinity.serif.com/en-gb The first real competition to Adobe's Illustrator may be an OS X exclusive, but Affinity Designer is a seriously powerful graphic design tool that costs an incredibly reasonable £40. OS SUPPORT Apple OS X 10.7.5 • MINIMUM CPU Core 2 Duo (64-bit) • MINIMUM GPU Intel HD Graphics • MINIMUM RAM 1GB • HARD DISK SPACE 325MB • DETAILS affinity.serif.com • PRODUCT CODE Affinity Designer • FULL REVIEW Mar 2015	
WEB DESIGN	COMPUTER SHOPPER BEST BUY	XARA Web Designer 10 Premium	
	★★★★★	£90 inc VAT • www.xara.com/uk This latest version is ideal for creating websites that work well on multiple devices, including phones and tablets. It's perhaps too simple for advanced web designers but is perfect for everyone else. OS SUPPORT Windows XP or later • MINIMUM CPU Intel Celeron/AMD Sempron • MINIMUM GPU Built-in graphics processor • MINIMUM RAM 500MB • HARD DISK SPACE 300MB • PRODUCT CODE N/A • DETAILS www.xara.com • FULL REVIEW Oct 2014	



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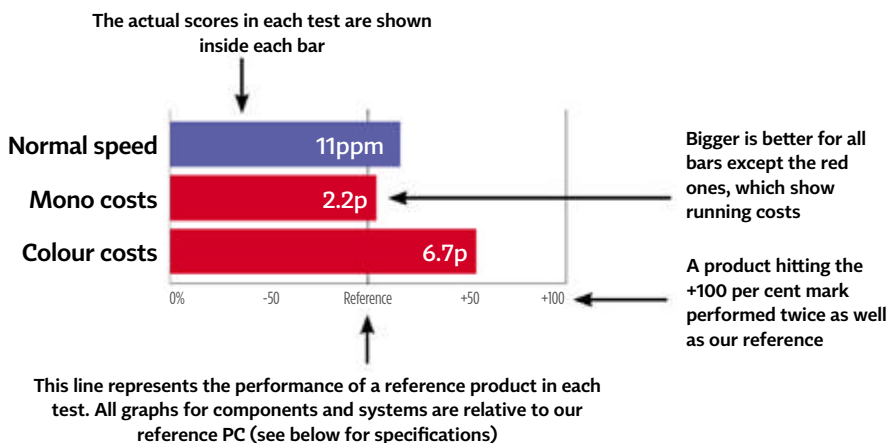


How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

COMPUTER SHOPPER'S REVIEWS use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the Reviews section, as shown on the right. Look in the 'Summary of tests' box (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See below for a brief description of our benchmarking software and game tests.



SUMMARY OF TESTS

PC SYSTEMS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications

Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

LAPTOPS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback

SMARTPHONES/TABLETS

Battery life	Run time in minutes for continuous video playback
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PRINTERS AND MFPs

Normal speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Mono costs	Running costs expressed as pence per page
Colour costs	Running costs expressed as pence per page

DIGITAL CAMERAS

Battery life	Number of shots from full charge
--------------	----------------------------------

CAMCORDERS

Battery life	Run time in minutes for recording
--------------	-----------------------------------

MP3 PLAYERS

Battery life	Run time in minutes for continuous playback
--------------	---

ROUTERS

Laptop 24GHz 10m	Mbit/s at 10m with laptop on 24GHz band
Laptop 24GHz 25m	Mbit/s at 25m with laptop on 24GHz band
Laptop 5GHz 10m	Mbit/s at 10m with laptop on 5GHz band
Laptop 5GHz 25m	Mbit/s at 25m with laptop on 5GHz band
Wi-Fi adaptor 10m	Mbit/s at 10m with a Wi-Fi adaptor
Wi-Fi adaptor 25m	Mbit/s at 25m with a Wi-Fi adaptor

NETWORK-ATTACHED STORAGE

Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files

HARD DISKS

Extra large files	Average MB/s for read/write of a 6GB file
Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files

PROCESSORS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

MOTHERBOARDS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

GRAPHICS CARDS

Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Tomb Raider	Frames per second at 1,920x1,080, SSAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

BENCHMARKS

SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, Mac OS X and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a netbook, laptop or desktop, from both sections of the magazine.

To see how your computer compares, you can download the suite from www.shopperdownload.co.uk/benchmarks. Versions are available for 32-bit and 64-bit operating systems.

3D BENCHMARKS

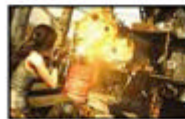
DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



TOMB RAIDER

With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.



METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.



RATINGS & AWARDS

Computer Shopper rates products out of five:

Avoid	☆☆☆☆☆
Below average	☆☆☆☆☆
Good	☆☆☆☆☆
Very good	☆☆☆☆☆
Excellent	☆☆☆☆☆

The best products can win the following awards:

BEST BUY

Products with outstanding quality and performance for the money win our Best Buy award.



RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.



BUSINESS

The very best products for work win our Business Buy award.



Product Reviews

Our guide to all the products reviewed in this month's *Shopper*

112
Reviews

Lead Product 26

Alienware 13 and Graphics
Amplifier

PCs & Laptops 28

Alienware Alpha
Asus Zenbook UX305
HP Stream 11
Syber Vapor K

PC group test 78

Chillblast Fusion Cyborg
Cyberpower Zeus Mini-A 100
DinoPC Stealth Sentinel
Mesh Elite Voyager CS
Overclockers Titan Dagger
Palicomp AMD Nemesis Cube
PC Specialist Invictus
Wired2Fire Diablo Ultima
YoyoTech Warbird RS6

Handhelds 34

Dell Venue 8 7840
HTC Desire 620
LG G Flex 2
Motorola Moto E (2nd Gen.)

Photography 40

Olympus PEN E-PL7
Samsung NX1

Displays 42

Acer S277HK
Samsung U32D970Q

Home Cinema 46

Onkyo TX-NR636
Panasonic Viera TX-55AX902B
Samsung UE65JS9000

Audio 50

Divoom Voombox Ongo
Philips Spotify Connect
SW750M
Pure Voca

Video 53

NZXT Doko

Dashboard camera group test 92

GoPro Hero4 Silver
Mio MiVue 518
Mio MiVue 538 Deluxe
Nextbase In-Car Cam 101 Go
Nextbase In-Car Cam 402-G
Professional

RAC Digital CarCam 01
RAC Digital CarCam 02
RoadHawk DC-2

Printers & Scanners 54

Canon Maxify MB5050
HP Officejet Pro 6230

Storage 56

Seagate Seven
Synology DiskStation DS215j

Networks 58

Draytek Vigor 2760Vn

Components 59

Gigabyte Z97X-UD5H-BK

Software 60

Propellerhead Reason 8
Corel VideoStudio X8 Ultimate

Games 62

Homeworld Remastered

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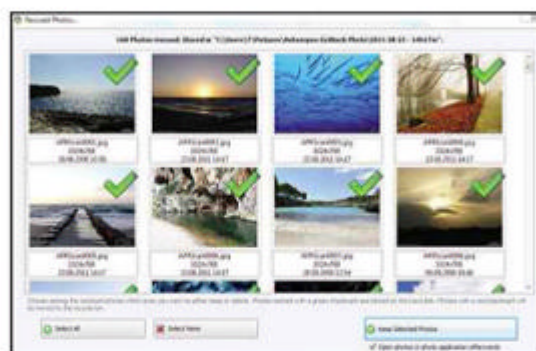


Ashampoo GetBack Photo

ASHAMPOO GETBACK PHOTO is an undelete program designed to recover lost digital images. Simply direct GetBack Photo to the local, external or network drive that contained the pictures you deleted and it goes to work, scouring every sector for the missing files.

There's comprehensive format support. This program isn't just for finding missing JPGs; GetBack Photo can also locate PNG, BMP, GIF and Raw files. It's even able to detect and recover photos contained in common document formats, including PDF and Word, although this won't happen by default (click Configuration, Settings and select Complex Scan to detect every format or Quick Scan for standard images only).

Running a full scan can take quite some time, particularly if the program is examining a very large disk. Leave GetBack Photo to work and when it's finished it will display a list of any recoverable images. This initial report includes thumbnails of every picture, making it easy to see what's been found.



By default GetBack Photo marks every photo for recovery, but it doesn't have to stay that way. Click an individual photo to turn recovery on or off, and it will be marked with a green tick or a red cross accordingly (or just click the Select All or Select None buttons at the bottom of the window).

Once you've chosen what you need, click Keep and the images will be recovered to your preferred destination folder (see Configuration, Settings). You'll also have the option to open them in your default viewer for further checks.

GETTING STARTED

The download instructions on the opposite page show you how to connect to the download site. Please make sure that you type in the web address exactly as shown. You'll need your coupon code the first time you log on.

ANY PROBLEMS

If you need help with any of the software this month, please send an email to letters@computersshopper.co.uk. We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

WHY DOWNLOADS

Software manufacturers have been requiring us to use online registration for some time now, but increasingly we're being asked to provide the program as a download. In order to continue bringing you the best free software, we've revamped our download site. You need to use the unique code printed in the box on the facing page to register and download the software in this issue.

The unique code means we stop the deals leaking online, so only Shopper readers get the software. You'll also enjoy a smoother registration, where we handle the registration process.

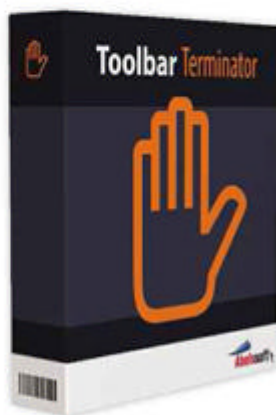
NO CODE?

If you don't have the card insert with the unique code, you must buy the £4.99 print version of the magazine. If you have bought this, please contact letters@computersshopper.co.uk for help and a new code.

REQUIREMENTS Windows XP, Vista, 7 or 8 32/64-bit, 50MB hard disk space

WEBSITE www.ashampoo.com

NOTES To get your code click 'Get free activation key' during setup. Follow the instructions, and your key will be displayed in a browser window immediately



Toolbar Terminator 2015

TOOLBAR TERMINATOR 2015 is a straightforward yet extremely useful tool that makes it exceptionally easy to find and remove even the most persistent of browser toolbars.

The program doesn't need any special configuration, and there are no complex options to consider. You don't even have to click a Start button. Just launch Toolbar Terminator 2015 and it immediately checks Internet Explorer, Chrome and Firefox for add-ons.

Anything the application discovers is presented in a list. Icons show whether the toolbar was installed in IE, Chrome or Firefox, and Toolbar Terminator 2015 also checks for remnants left behind in Windows, such as Registry keys.

The toolbars displayed won't necessarily be malicious, and it's important to browse the report with care. Toolbar Terminator 2015 highlighted entirely safe and legitimate Avast and IObit toolbars on our test system, for instance. Check the list on your own PC and be sure to clear the tickbox to the left of anything you want to keep.

Once you're finished, click Remove and Toolbar Terminator 2015 will hunt down and eliminate every last trace of your unwanted add-ons. By default the program also restores your preferred home page, which is useful if some cheeky software has changed it to something else.

If you're particularly toolbar-averse, click Settings, tick 'Scan system automatically after user logon', and Toolbar Terminator 2015 will automatically alert you to problems whenever you log in.

REQUIREMENTS Windows XP, Vista, 7 or 8 32/64-bit, 30MB hard disk space

WEBSITE www.abelssoft.net

NOTES Unlock the software by providing your name and email address before it can be used. Just follow the instructions in the pop-up displayed when Toolbar Terminator is first launched.

Chat and Communication

Digsby (Build 92) Access all your instant messaging services from one application; there's support for Windows Live!, Yahoo!, AIM, Google Talk, ICQ and Jabber.

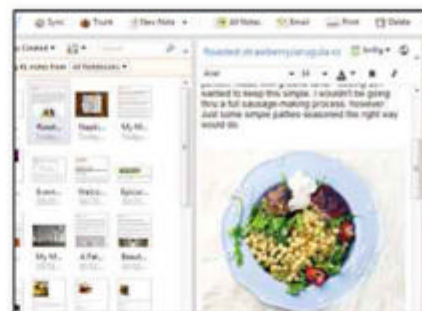
UPDATED Evernote 5.8.4 Store your notes, ideas and plans in the cloud, and synchronise them between computers.

UPDATED Mozilla Thunderbird 31.5 A powerful email client from the organisation best known for the Firefox web browser.

Postbox Express 1.0.1 An email client that provides a comprehensive array of tools to help you manage your messages more easily.

UPDATED Skype for Windows 7.2 Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

Trillian 5.5.0.19 Use all your instant messaging accounts with one application; this program has support for Windows Live!, AIM, Yahoo! and Google Talk.



Customisation

7 Taskbar Tweaker 4.5 Customise the Windows 7 taskbar so that it works exactly to your liking.

Metro UI Tweaker for Windows 8

Tweak the new user interface for Windows 8.

Mosaic Desktop Beta 1 Refresh Add Windows 8's mosaic-tiled desktop to your computer without having to upgrade.

Rainmeter 3.1 Customise the desktop quickly and easily with your choice of information, tools and shortcuts.

Windows 8 Transformation Pack 9.1

Emulate the look of Windows 8 on an earlier version of the operating system.

Windows 10 Transformation Pack 2 Bring some of Windows 10's new features to your current operating system.



General

Free Studio 6.5 This software provides an easy way to convert your video and audio files into different formats.

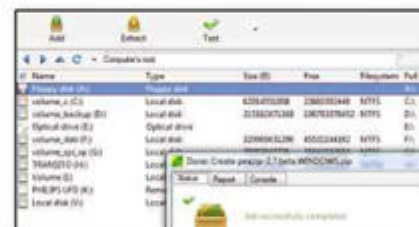
Paragon Partition Manager 2014 Free Create, format, split, merge and reorganise all your hard disk's partitions.

PeaZip 5.5.3 A tremendously powerful archive-management tool.

Screenshot Captor 4.9.3 Create and manage screenshots the easy way.

SUMo 3.13 Quickly scan your PC's installed applications and find any updates available for them.

ZipGenius 6.3.2 A flexible file-compression tool with support for a huge number of compressed file formats.



Internet and Network

UPDATED CarotDAV 1.11.13

Manage all your online storage services with one simple application.

UPDATED Cyberduck 4.6.5 A powerful but easy-to-use FTP client.

Easy WiFi 4.01

Find free Wi-Fi hotspots while you're out and about.

UPDATED NetBalancer 8.5.4 Make the

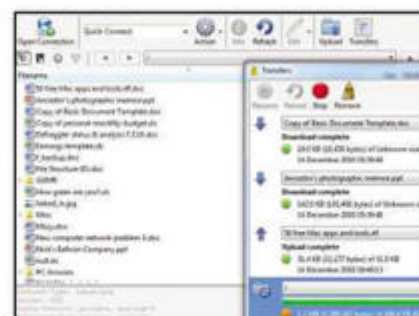
most of your internet connection by assigning download and upload priorities to web applications.

TeamViewer 10.0

Remote-control your computer from anywhere in the world.

Vuze 5.4

A BitTorrent client to help you locate, share and download torrent files.



Tweaking and Performance

UPDATED CCleaner 5.0.3 Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

Defraggler 2.18 Ensure that your system is defragmented properly and improve its performance with this useful defrag tool.

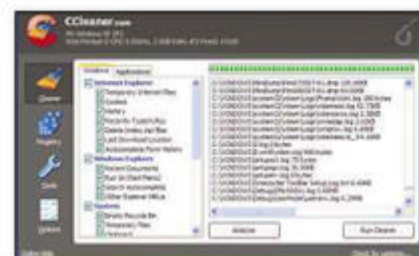
Finestra Virtual Desktops 2.5 Set up four or more virtual desktops on your PC.

IObit Advanced SystemCare 8

A complete computer security, maintenance and optimisation suite.

Revo Uninstaller Free 1.95 Remove installed applications completely, including all their folders, system files and Registry entries.

Simple Performance Boost 1.0.5 Tweak the Windows Registry to give your PC a performance boost.



Crafting PCs the Scan way: Specification. Service. Satisfaction.



Scan V1 Value System Home / Office PC

- Intel® Pentium® G3240 processor
- 4GB Corsair DDR3 1333MHz memory
- 500GB SATA 6Gb/sec hard drive
- Windows 8.1

£299 Inc VAT

The V1 is a very capable entry-level system perfect from basic home/office tasks. It's based around the dual-core Intel® Pentium® G3240 processor, 4GB of RAM plus a 500GB hard disk.



Scan V15 Value System Home / Office PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£489 Inc VAT

The V15 ups the ante by including a quad-core Intel® Core™ i5 4460 processor, so it makes light work of office and multimedia applications.



Scan G20 Value System Gaming PC

- Intel® Pentium® G3240 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 750 Ti SSC
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£489 Inc VAT

Thanks to its dual-core Intel® Pentium® G3240 processor and NVIDIA GTX 750 Ti SSC graphics card the G20i is our most affordable gaming PC. It even includes surround sound!



Scan G30i Value System Gaming PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 760 SC ACX
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£685 Inc VAT

The combination of quad-core Intel® Core™ i5 4460 processor and NVIDIA GeForce GTX 960 SSC ACX graphics card ensures that the G30i can play any game you throw at it.



Get the best of work and play with the new Windows.



Scan Value PCs

A range of computers perfectly suited for the home/office. These affordable PCs are very flexible workhorses, capable of every task, from email/web surfing to high-end applications such as photo editing, video encoding and gaming. All of our Value Systems are pre-built and soak-tested so are ready to ship for next-day delivery.



Finance Available on
PCs above £300



Built by award
winning 3XS team



Fully soak tested



Fully 3XS
compatible



Ready to ship



2 Year Warranty
Part + Labour



The most awarded PCs and Laptops Period.



Scan 3XS Gamer Gaming PC

- Intel® Core™ i3 4160 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 750 Ti
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1
- 3 Year Premium Warranty

£559 Inc VAT

The Scan 3XS Gamer is an affordably-priced gaming rig that includes a dual-core Intel Core i3 4160. Also included in the default spec is a 2GB NVIDIA GeForce GTX 750Ti graphics card, 8GB of 1600MHz Corsair Vengeance DDR3, a Asus H81 motherboard and 1TB hard disk.



Scan 3XS Gamer 20i Gaming PC

- Intel® Core™ i7 4790 processor
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 970 SC ACX
- 1TB Seagate HDD
- Windows 8.1
- 3 Year Premium Warranty

£1054 Inc VAT

The 3XS Gamer 20i is a super-fast gaming PC thanks to its combination of quad-core Intel Core i7 4790 CPU running at 3.6GHz with added Hyper-Threading plus a 4GB NVIDIA GeForce GTX 970 graphics card. These components are installed in an Asus Z97-K motherboard along with a 1TB hard disk.



3XS Graphite LG157 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960M
- 15.6in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£935 Inc VAT

The LG157 is a 15.6" mid-range gaming laptop that includes a NVIDIA GeForce GTX 960M graphics card plus an Intel Core i7 4720HQ CPU, up to 16GB of RAM and multiple hard disks and SSDs. The LG157 is ready for next-day delivery in late March and is protected by a 2 Year Premium Warranty.



3XS Graphite LG1720 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 3GB NVIDIA GeForce GTX 970M
- 17.3in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

£1159 Inc VAT

The LG1720 is a 17.3" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1720 is ready for next-day delivery and has a 2 Year Warranty.



Scan Computers recommends Windows.

3XS Custom Series

Our 3XS Custom Series is a range of computers designed to offer the best performance for a variety of applications, with a particular focus on games. We build Custom Series PCs to order, so we can configure and tailor make an individual PC just the way you want it. We can also overclock the processor, so you get a faster PC without a substantial increase in price. All 3XS Custom Series PCs are covered by a three year warranty as standard with the first year on-site.



Scan 3XS Overclocked



Built by award winning 3XS team



3 Year Warranty

3XS SYSTEMS



ULTIMATE DESKTOPS

£500 PCs

With fast processors, powerful graphics cards and room for upgrades, these nine complete systems will cater to your every need – and all for just £500

CONTENT REVIEWS

Page 80

CHILLBLAST Fusion Cyborg

Page 81

CYBERPOWER Zeus Mini-A 100

Page 82

DINOPC Stealth Sentinel

Page 83

MESH Elite Voyager CS

Page 84

OVERCLOCKERS Titan Dagger

Page 85

PALICOMP AMD Nemesis Cube

Page 86

PC SPECIALIST Invictus

Page 87

WIRED2FIRE Diablo Ultima

Page 88

YOYOTECH Warbird RS6

ALTHOUGH BUILDING YOUR own PC (see page 102) will get you the exact components you want, it can be a hassle. It also won't work out cheaper than buying a pre-built computer, such as one of the models on review here.

This month we've challenged the UK's system builders to provide powerful desktop PCs for £500 (£600 with a monitor). As you'll see from our reviews, the competition was tight, meaning whichever manufacturer you pick, you'll be getting a good deal. But what should you be looking out for?

CASE IN POINT

Unusually for a PC group test we have a variety of form factors on show, including

cases that support full-size ATX and microATX motherboards. The obvious difference between these standards is the overall case size, but it also makes a difference when considering future upgrades. If there aren't many extra SATA connectors and drive bays, you won't be able to add much in the way of extra storage. A lack of PCI-E slots means you won't be able to add many expansion cards such as sound cards or wireless adaptors. Finally, a lack of memory slots means you'll be limited as to how much RAM you'll be able to add to your PC if you need it in the future.

We also look at how much attention to detail has gone into the assembly of the PC, including how carefully cables have been routed through the case and whether components have been securely mounted. We keep our ears tuned to the sound of the fans when the PC is both idling and at full power, so you can get an idea of whether the PC is going to keep your family awake at night.

All the PC manufacturers here have easy-to-use configurators on their websites to help you choose your own components, though some are rather inflexible and you may be charged significantly more if you make any changes to the specifications in our reviews, even if it's only a minor change.

CHIP SHOP

There's lots of variety in terms of processors this month, but these can be boiled down to two different schools of thought on what the PC vendors reckon you want from your PC.

First, there are models with mid-range quad-core chips. These processors are great all-rounders, and while performance in basic tasks such as web browsing and gaming isn't much better than that of cheaper chips running at similar clock speeds (measured in gigahertz, or GHz), these processors truly shine when it comes to complex multimedia tasks such as photo and video editing, and are also much more capable when you have several tasks on the go at once.

The other camp has plumped for cheaper dual-core chips. These will whizz through basic tasks and are perfect for games, but performance when exporting videos and running multiple tasks may be slower.

Some chips have been overclocked and, if cooled adequately by air or water, can produce some giant-killing performances that embarrass processors four times the price.

PLAY TIME

All but two of the PCs in this month's test have discrete graphics cards. This means you don't have to rely on the processor's slow integrated graphics chip. With the tight £500 budget, the power of the graphics card you'll get will depend on how much cash has been invested in the processor.

Some chips have been overclocked and, if cooled adequately, can produce some giant-killing performances that embarrass processors four times the price

It's the graphics card that will make the biggest difference when playing games; the processor will only be a bottleneck in extreme situations that you're only likely to encounter with today's top-end titles. If you want to play games, then PC builds with Nvidia's new GeForce GTX 960 card or AMD's R9 270 or 270X are your best bet. Otherwise, choose a PC with a more powerful processor for nippier overall desktop performance.

MONITORING THE SITUATION

We've asked all the PC builders to send in a monitor they'd bundle with their systems. Some chose quality panels, while others supplied screens we would enthusiastically encourage you to avoid. You can of course choose to buy your PC without a monitor, but if your objective is to get a complete

package for £600, you should take this part of the bundle seriously.

Every manufacturer provides Full HD screens, but that's where their similarities end. Some are small 21.5in panels, while others measure a more spacious 24in. We'll tell you in our reviews how much of the sRGB colour gamut they're able to cover, their contrast ratios and how wide the viewing angles are.

DRIVE TIME

Most of the PCs on test here are sold with one hard disk, usually a 1TB mechanical drive. Some also come with a smaller SSD. Having an SSD makes loading times much faster and can improve gaming performance a little, too. It also significantly reduces the time you'll spend waiting for your PC to boot, and any

files stored on the SSD will be found and opened quicker when you search for them.

PERIPHERAL VISION

All the system builders have included keyboards and mice in the price of the system. These often aren't very good, but some excel both in terms of style and feel. Even the ones that don't are a handy starting point when you first set up your PC, but in most cases they're cheap and replaceable.

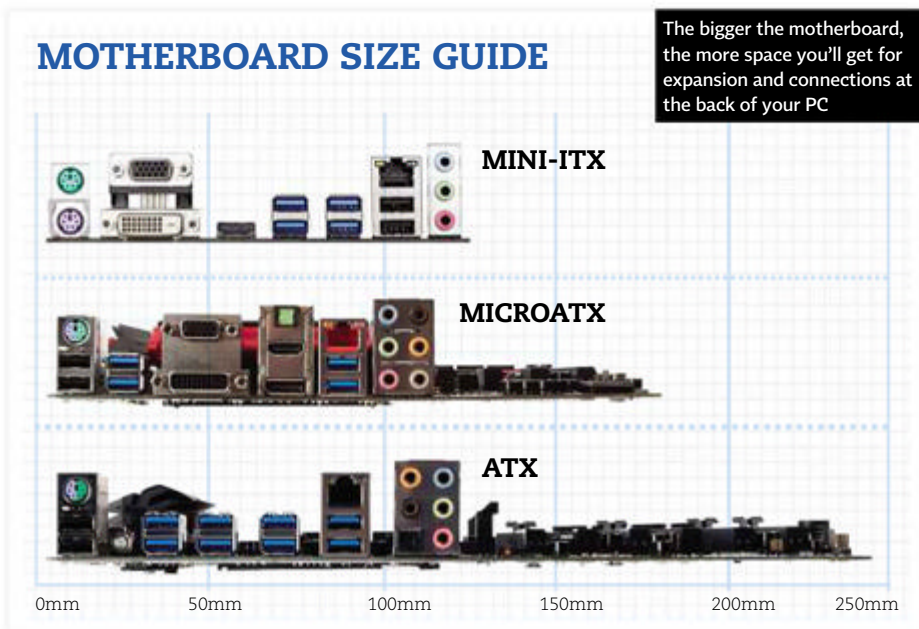
SEVENTH HEAVEN

All the PCs here come with Windows 8.1 as standard. However, some firms bought hundreds of Windows 7 licences before the operating system was discontinued. If you really don't like Windows 8.1, you should be able to 'downgrade' for free. We'll tell you in the table on pages 90-91 if this is possible.

DUCK AND COVER

As much as we'd like to pretend all PCs are perfect, we know they can go wrong from time to time. Luckily, all our suppliers this month have two- or three-year warranties that will cover you if components fail. They vary wildly, though, so we describe each warranty in detail in our reviews because we feel this can sometimes be an overlooked part of the PC buying process. If you want peace of mind, you should really know what sort of warranty you're getting.

All warranties cover labour for the length of the warranty. Some warranties also cover replacement parts, the value of which should not be underestimated. Finally, the best warranties – called collect and return – also cover shipping to and from the site of repair. Return to base (RTB) cover requires you to organise and pay for delivery and collection, so you should take that into account.



CHILLBLAST

Fusion Cyborg



£600 inc VAT • From www.chillblast.com

VERDICT

Powerful, compact and with a great warranty, the Chillblast Fusion Cyborg is a terrific desktop PC

CHILLBLAST'S FUSION CYBORG is an unusual-looking PC that uses the Zalman T4 Mini case. The chassis is outrageously cheap at just £15, but it's well made and has room inside for future expansion. It's just 364mm deep and 427mm tall, which makes it look a bit squashed, but its compact microATX form factor means it will fit on or under most desks.

Despite its low price, the chassis looks reasonably sturdy with a matt black plastic front and metal sides. Remove the side of the case and you're greeted by a compact but tidy PC that has plenty of power.

It's relatively quiet in use, too, as there's only one case fan: a 120mm exhaust fan at the rear of the chassis. The stock Intel CPU cooler runs quietly and the graphics card fan only kicks in after several minutes of gaming, but even then it's only a background whoosh that will be drowned out by your desktop speakers or headphones. In fact, the noisiest part of the PC is the hard disk, a 1TB Seagate SSHD, which rattles away even while the PC is idle.

The quad-core Intel Core i5-4460 processor runs at its base clock speed of 3.2GHz, Turbo Boosting to 3.4GHz when thermal conditions allow. Paired with 8GB of 1,600MHz DDR3 RAM in the form of two 4GB sticks, the processor clocked some great performances in our new benchmarking tests. It scored an excellent 98 in the image-processing test and managed respectable scores of 82 and 71 in



the video conversion and multitasking tests. If you're planning on editing video and high-resolution photos, you'll have no problem doing so on the Fusion Cyborg.

Graphics are handled by a 2GB PowerColor AMD R9 270X graphics card, a mid-range GPU that sits just behind the current-generation Nvidia GeForce GTX 960 in performance terms. It impressed in our latest gaming tests, producing an average frame rate of 75.5fps in our Dirt Showdown benchmark running at a Full HD resolution and Ultra settings. It also performed well in the Metro: Last Light Redux

Externally, there are eight USB ports, but only three are high-speed USB3 connectors. One of these is on the front of the case, while the remaining two are at the rear. There are four more USB ports at the rear and a fifth on the front of the case alongside the 3.5mm audio input and output. There are three more 3.5mm connectors at the rear of the case, a PS/2 port and a Gigabit Ethernet port, too. The graphics card has two DVI connectors and single HDMI and DisplayPort connectors.

The supplied AOC e2250wda monitor has decent viewing angles and colour accuracy.

Paired with 8GB of RAM, the processor clocked some great performances in our new benchmarking tests

benchmark, managing an almost-playable 27.7fps with the game on Very High settings and extremely challenging SSAA switched on. Turning SSAA off raised the frame rate to a smooth 50.5fps and proves the R9 270X still has some life in it for years to come.

The Gigabyte GA-B85M-D3H motherboard leaves a little room for expansion. The board has a single PCI-E x16 slot and two x1 slots, though the graphics card obstructs the top slot. There are four RAM slots, two of which have been filled, so you have room for more RAM if you need it in future; 8GB should suffice for most moderately challenging tasks, though.

Elsewhere, there are four SATA3 connectors, of which three are unused, and a further two SATA2 connectors. However, the case only leaves room for one more 3½in or 2½in hard disk or SSD, which will have to be mounted awkwardly facing upwards in the case. There's also no DVD drive included, which won't be a problem if you obtain your games and movies digitally. If you really want an optical drive, you can spend £20 using Chillblast's online configuration tools or buy and fit your own later.

We measured a contrast ratio of 1,046:1 and the display capable of producing 88.8% of the sRGB colour gamut. Our one minor issue is that we found a small amount of backlight bleed around the edges of the screen when it was displaying darker scenes. The supplied Zalman keyboard and mouse are perfectly usable but ultimately unspectacular.

Chillblast's excellent five-year warranty is collect and return for two years and labour only for an additional three years.

The Chillblast Fusion Cyborg is a compact and quiet gaming PC capable of excellent performance considering its low price. While there isn't much room for future expansion, it's a well-balanced system that we'd heartily recommend to anyone on a tight budget.



SPECIFICATIONS

PROCESSOR Quad-core 3.2GHz Intel Core i5-4460
RAM 8GB
FRONT USB PORTS 1x USB3, 1x USB
REAR USB PORTS 2x USB3, 4x USB
TOTAL STORAGE 1TB SSHD (8GB SSD cache)
GRAPHICS CARD 2GB PowerColor Radeon R9 270X
DISPLAY 22.5in AOC e2250wda
OPERATING SYSTEM Windows 8.1
WARRANTY Two years collect and return with parts, three years labour-only RTB
DETAILS www.chillblast.com
PART CODE Fusion Cyborg

CYBERPOWER

Zeus Mini-A 100



£599 inc VAT • From www.cyberpowersystem.co.uk

VERDICT

A compact PC with built-in 802.11ac Wi-Fi, the Zeus Mini-A 100 is loud and graphics performance isn't great

CYBERPOWER'S ZEUS MINI-A 100 is a compact PC with a tiny footprint that aims to bring gaming performance to modest setups at a low cost. The lack of a dedicated graphics card may seem an odd choice, but the AMD A10 APU helped this PC put in an impressive performance without a dedicated GPU.

The compact Mini-ITX case is a design unique to Cyberpower, but we were left a little underwhelmed in places. In particular, because of the compact nature of the case, there are plenty of wires on display, and while this can be put down to the limited working space, it's still not pretty once you take the side off.

It's not all bad: the chevron-shaped grilles on the sides of the PC have an industrial feel to them and are available in red or green, with matching power and front panel lights.

The quad-core 3.7GHz AMD A10-7850K APU, while not the most powerful processor, is great value and has decent 2D performance and impressive graphics capabilities thanks to its onboard AMD R7 graphics core.

Application performance in our tests was good, with the Zeus Mini-A 100 managing an overall score of 53. In the challenging 4K multitasking test, however, it scored just 44. While it was able to play 4K video smoothly while converting videos and photos in the background, the process took an age, which is why it scored so poorly. If you want to do processor-intensive tasks, it's best to leave the PC to get on with just the one job.

The single-core image rendering test was a high point, with the Zeus Mini-A 100 scoring 70. Browsing the web is effortless and pages were quick to load, while more complex tasks such as photo editing are possible; it's just the intensive tasks that may take a little longer.



Graphics performance is reasonable. In Dirt Showdown at Full HD resolution and Ultra settings it managed 18.3fps, which isn't playable. Metro: Last Light Redux was even more of a struggle: 5.3fps was all we could manage running at Full HD. You'll need to drop the settings to Medium and switch off graphical eye candy, such as anti-aliasing, to get decent performance out of modern 3D games or play them at lower resolutions.

The tiny case means expansion is extremely limited. There's room for one extra hard disk alongside the slot-loading DVD-RW

also find two USB ports on the front of the case, alongside two 3.5mm audio jacks.

We love the bundled Cooler Master Devastator keyboard and mouse set, although their blue backlighting clashes with the red LEDs of our review model's case. You also get a 22in AOC E2250SWDN monitor in the £599 package, but this is best avoided. While it has excellent colour coverage – we measured it covering 94% of the sRGB gamut – viewing angles are narrow and contrast is just 379:1, which makes for disappointing image quality. Better panels are available for less money.

An Intel 802.11ac Wi-Fi adaptor makes this PC versatile in terms of where you'll be able to put it in your house

drive and 1TB hard disk, although gaining access to the enclosure is an exercise in damage limitation and is very fiddly. The MSI A88XI AC motherboard is suitably compact, but you'll still find two spare SATA3 ports if you somehow squeeze an extra hard disk into the chassis. There's also a PCI-E x16 slot for a dedicated graphics card, but if you choose to fit your own card it will have to be very compact as there's very little room for it.

There's a decent array of connectivity on the motherboard, including an Intel 802.11ac Wi-Fi adaptor, which makes this PC versatile in terms of where you'll be able to put it in your house. If you use it as a living-room PC, for example, and your router is in another room, you won't have to trail an Ethernet cable to your PC just to watch Netflix.

At the rear are three 3.5mm audio outputs, two USB3 ports and four more USB ports alongside VGA, HDMI and DVI ports and a Gigabit Ethernet connector. There's also an optical audio S/PDIF output, so you'll be able to connect to high-end sound systems. You'll

Cyberpower's standard warranty is one of the best available, with two years of parts cover coming as standard and a further year of labour also included. After the first month, where Cyberpower will pay for a courier to collect and return a faulty PC, you'll have to cover the shipping costs if you machine requires repair.

The Cyberpower Zeus Mini-A 100 is a decent small form-factor PC that's easily powerful enough for everyday desktop and multimedia tasks. Gaming isn't beyond its reach, either, but the lack of a dedicated graphics card hurts. Its thin design means it would be an ideal living-room PC, but if you have ambitions beyond watching movies you should look at a system with a separate GPU, such as Chillblast's Fusion Cyborg.



SPECIFICATIONS

PROCESSOR Quad-core 3.7GHz AMD A10 7850K
RAM 8GB
FRONT USB PORTS 1x USB3, 1x USB
REAR USB PORTS 2x USB3, 4x USB
TOTAL STORAGE 1TB hard disk
GRAPHICS Integrated AMD Radeon R7 200-series
DISPLAY 21.5in AOC E2250SWDN
OPERATING SYSTEM Windows 8.1
WARRANTY Three years RTB including two years parts
DETAILS www.cyberpowersystem.co.uk

DINOPC Stealth Sentinel



£599 inc VAT • From www.dinopc.com

VERDICT

A big SSD and quality monitor help to elevate the quiet Stealth Sentinel, but 2D performance is a little lacking

DINOPC'S STEALTH SENTINEL is one of the quietest budget gaming PC's we've tested, largely thanks to its quality Corsair 100R Silent case and quiet case fans. It also helps that DinoPC hasn't included the most potent components in its build, but the Stealth Sentinel still puts in decent performance.

The Corsair case isn't just well insulated from noise, it also manages to combine simplicity with style. Due to the lack of front intake fans, the case has no honeycomb panels on the front or side, which gives the matt black chassis a stylish and uniform look. Take the left side off the case and you'll be presented with a surprisingly bare build. This is largely due to the use of a microATX motherboard and the fact that the graphics card is only the length of a PCI-E x16 slot.

The use of an SSD means the drive bays appear less cluttered, and the lack of a DVD-RW drive means there's not much going on inside. Still, it's a neat build and there's a bit of room for future expansion.

There are two USB3 ports and two 3.5mm audio jacks at the front of the chassis while at the rear you'll find a further four USB3 connectors and two slower USB ports, as well as three 3.5mm audio jacks. The graphics card has a fairly limited selection of ports; there are two DVI connectors and a Mini HDMI port.

There's a dual-core Intel Core i3-4160 processor running at its base clock speed of 3.6GHz, which means it whizzes through most basic tasks with ease. More complicated multimedia jobs are hampered by its lack of cores, however. Hyper-Threading technology



adds two more virtual cores, but it wasn't enough to save this PC from a merely average score in our multimedia benchmarks. Image editing was its strong point, with the Stealth Sentinel scoring 92 in this test. Scores of 57 in the video rendering and 45 in the multitasking tests, while not exactly slow, do fall some way short of some of the Core i5 processors we've seen in other similarly priced PCs.

Just below the processor is a 2GB Zotac Nvidia GeForce GTX 750 Ti graphics card. This

than a full-size board, so this cost-saving measure may cause issues in the future. For buyers who have no desire to expand, though, it will be less of a problem. In addition to the three free SATA connectors, there's a PCI-E x1 slot for a sound card or wireless adaptor, and there's also room for three more 3½in or 2½in hard disks or SSDs. There's also room for two optical disk drives.

The Iiyama ProLite GE2488HS-B1 monitor is excellent for the price: it's a 24in Full HD

The 24in Iiyama monitor is excellent, with fast response times, decent colour accuracy and high contrast levels

is widely regarded as an excellent and highly-efficient budget graphics card.

We put the 750 Ti through its paces in our Dirt Showdown benchmark first, where it achieved a playable 47.7fps average frame rate. Metro: Last Light Redux caused the card a few problems, and it turned in an average frame rate of just 18.5fps. Disabling super sampling anti-aliasing improved this to 32fps, but we found turning texture filtering down from 16x to 4x and reducing the overall quality to High was the best bet, improving things to a more stable 46fps.

DinoPC has ditched mechanical hard disks in favour of a 240GB Kingston SSD. It's a decision that should pay off for those who have a limited number of programs and games they want to access quickly. Those who have large photo or video collections may be less happy with this (solid) state of affairs, but if you're migrating from an older PC there's no reason why you can't move your high-capacity HDD into this case and connect it to one of the three free SATA connectors.

As the Gigabyte GA-H81M-S2H motherboard uses the small microATX form factor, there's less room for future expansion

panel with fast response times, decent colour accuracy of 92.5% of the sRGB gamut and high contrast levels of 1,243:1. If you're in the market for a monitor upgrade, you could do worse than buy it in this PC bundle.

DinoPC's three-year warranty isn't the most generous. You get a year of parts and labour cover followed by two more years of labour-only cover. The whole three years is covered under an RTB warranty, meaning you're responsible for the delivery of the PC to the manufacturer for repair if a fault develops after 30 days of ownership.

The DinoPC Stealth Sentinel is a good all-round package encompassing a quiet PC, high-quality monitor and a generous SSD. However, aside from its strengths, it lacks the overall processing power that other PCs in this price range offer, and the Chillblast Fusion Cyborg is a better choice.

SPECIFICATIONS

PROCESSOR Dual-core 3.6GHz Intel Core i3-4160
RAM 8GB
FRONT USB PORTS 2x USB3
REAR USB PORTS 4x USB3, 2x USB
TOTAL STORAGE 240GB SSD
GRAPHICS CARD 2GB Zotac GeForce GTX 750Ti
DISPLAY 24in Iiyama ProLite GE2488HS-B1
OPERATING SYSTEM Windows 8.1
WARRANTY Three years RTB including one year parts and first 30 days collect and return
DETAILS www.dinopc.com
PART CODE Stealth Sentinel



MESH**Elite Voyager CS**£599 inc VAT • From www.meshcomputers.com**VERDICT**

A compact PC with a good monitor and built-in Wi-Fi, but it's crying out for a better processor

MESH'S ELITE VOYAGER CS is as compact as desktop PCs come. Its footprint is smaller than most tower cases so it can be tucked away on a desk or near a TV, depending on how you plan to use it. It also has built-in 802.11ac Wi-Fi, which is a handy addition for those with slightly awkward home networks. It's also short at just 290mm high, so the top will be in easy reach if you store paperwork, coffee cups and desk toys on it.

The Corsair Obsidian 250D is an expensive case and, while it looks great from the outside, it doesn't lend itself to tidy PC builds. This is a shame, because a window on the top of the case allows you to look at the builder's handiwork, but because of a lack of cable gutters and vanity panels, all the cables used in the build are visible and look a bit messy.

The front of the case has two USB3 ports, but annoyingly they're mounted upside down. At the rear are a further four USB3 and two USB ports, plus six 3.5mm audio connectors, two Gigabit Ethernet ports, the wireless receiver and an S/PDIF audio connector. There are also three video output ports, with DVI, HDMI and DisplayPort all present.

While the Elite Voyager isn't the quietest PC we've tested, it's not too noisy even when the PC is under load. Handling processing demands is a dual-core 3.6GHz Intel Core i3-4160 processor paired with 8GB of 1,866MHz DDR3 RAM. It performed admirably in our benchmarking tests, with a score of 91 in the image-editing test hinting at nippy single-core performance in basic tasks. Scores of 61 and 48 in the video-processing and multitasking tests respectively are pleasing,



too, although we can't help but feel that perhaps a cheap quad-core AMD chip could have led to better overall performance.

We had performance issues brought on by the pre-installed BullGuard Internet Security suite. Until we uninstalled it, our review PC was a bit stuttery but, more irritatingly, constantly hamstrung by BullGuard's laughably overzealous restrictions in which programs it blocks from accessing the internet. For example, it asked us whether we wanted Internet Explorer to be allowed to access the

slots are filled, too, so you'll need to buy two 8GB sticks if you want 16GB of memory.

Unusually, Mesh has bundled a 22in BenQ GW2255 Full HD monitor that has a VA (vertical alignment) panel instead of TN or IPS. The advantage of this technology is sky-high contrast and great viewing angles, both of which were present in our review model. Colour coverage wasn't great with just 88% of the sRGB colour gamut covered, but the high 2,650:1 contrast levels we measured mean it will be great for watching movies and

A window on the top of the case allows you to look at the builder's handiwork, but all the cables look a bit messy

network – twice. Aside from this, Mesh hasn't installed any other bloatware on the PC.

There's no dedicated graphics card in the Elite Voyager CS so you're limited to basic productivity and media tasks. If you have no interest in gaming this won't affect you, but for the sake of completeness we ran our graphics benchmarks anyway. Unsurprisingly, the onboard Intel HD Graphics 4400 failed our Dirt Showdown test and produced a slideshow 4fps in the Metro: Last Light Redux test.

Adding extra hardware to the Elite Voyager is possible, but you'll have to remove several case panels to gain access to the components you want. If you want to replace the 120GB Patriot Blaze SSD or the 1TB Seagate hard disk or add an extra disk of your own (there's one free bay and one free SATA3 port) you'll need to remove a panel at the rear, the left side panel and the panel on the top of the chassis. There's room for a dedicated graphics card in the PCI-E x16 slot on the MSI Z97I AC motherboard, too. There are no other PCI or PCI-E slots on the board, so any extras you want to add will need to be USB dongles. Both RAM

TV shows with dark scenes without having to bump up the brightness of the monitor.

The Microsoft Wired Desktop 600 keyboard and mouse are what you'd expect from a budget peripherals set; their only features are a play/pause button and volume control. Still, they're a good starting point.

Mesh's warranty is competitive. Your cover begins with a year of collect and return cover and two years of parts cover, and labour is covered for the lifetime of the machine.

The Mesh Elite Voyager CS is a decent compact PC but it lacks the overall power of similar machines in this price range. The lack of a quad-core processor and dedicated graphics means it's not as fast as its rivals. The presence of 802.11ac Wi-Fi, an SSD and the well-made case are highlights, but you can get more for your money with the similarly sized Palicom AMD Nemesis Cube.

**SPECIFICATIONS**

PROCESSOR Dual-core 3.6GHz Intel Core i3-4160
RAM 8GB
FRONT USB PORTS 2x USB3
REAR USB PORTS 4x USB3, 2x USB
TOTAL STORAGE 120GB SSD, 1TB hard disk
GRAPHICS Integrated Intel HD Graphics 4400
DISPLAY 22in BenQ GW2255
OPERATING SYSTEM Windows 8.1
WARRANTY One year collect and return, two years parts, lifetime labour
DETAILS www.meshcomputers.com
PART CODE Elite Voyager CS

OVERCLOCKERS

Titan Dagger



£622 inc VAT • From www.overclockers.co.uk

VERDICT

An attractive PC with capable components, but performance is slightly lacking for the money

THE TITAN DAGGER comes with everything you need to get started in the world of PC gaming and plenty of space to upgrade in the future. The Dagger looks sharp thanks to its cheap yet stylish BitFenix Neos case, which comes in eight colour combinations, including the black and blue in our review unit.

Take off the side panel of the chassis and you'll find neatly packaged components and, surprisingly, a Prolimatech water cooler for the dual-core Pentium G3258 processor. This chip is ripe for overclocking and Overclockers has taken it from its base speed of 3.2GHz to 4.2GHz. The water cooler is quieter than most CPU fans and kept the processor cool as it ran through our challenging new benchmarks.

The high clock speed means the image-editing test was completed in under two minutes, giving the system a score of 92. That's just eight points off an Intel Core i5-4690K. However, because the processor is a dual-core chip, performance fell off in the challenging multicore tasks: it scored 59 in the 4K video-rendering test and 42 in the multitasking challenge, giving it an overall score of 56. This PC will fly through basic tasks, though, with web pages and productivity software opening in a flash. If you're going to be editing video, however, expect things to take a bit longer.

The 2GB Nvidia GeForce GTX 750 Ti is the cheapest graphics card available with the Titan Dagger, keeping the price near our £600 target. While this card is an excellent entry-level GPU, some games will need

tweaking to get them to run smoothly. Dirt Showdown ran at a smooth 47fps in our tests, but 18.3fps in Metro: Last Light Redux is too low to be considered playable. Knocking down super sampling anti-aliasing we managed to raise this to a more playable 33fps, however.

The build is tidy and cable management is about as tight as it could be, although as the case has no window you won't be able to appreciate the PC builder's handiwork. If you

and a PCI-E x1 slot for a sound card or wireless adaptor. There's no room for more RAM, however, because two 4GB 1,600MHz DDR3 memory modules fill both slots. You can upgrade to 16GB of RAM, but you'll have to replace both modules with more expensive 8GB sticks instead of cheaper 4GB sticks.

The quality of the monitor in this bundle doesn't quite match the superb PC build. The 21.5in Full HD BenQ DL2215 covered a

Take off the side panel of the chassis and you'll find neatly packaged components and a Prolimatech water cooler

want to replace parts in the future, make sure you have a pair of scissors handy as there are cable ties aplenty inside the Titan Dagger.

You get a single 1TB Seagate Desktop hard disk in this base specification model, but there's plenty of room for expansion for extra drives later. There are two SATA3 ports and two SATA2 ports, and two are free after the DVD drive (not present in our review model but part of the base specification) and hard disk are accounted for. There's also space for

three 2½in SSDs, two extra 3½in hard disks and two optical drives, so you can mix and match as you please.

On the rear of the PC are four USB ports, including two USB3 connectors, with two USB ports on the front, one of which is USB3-compatible. There are also three 3.5mm outputs at the rear in addition to the two at the front of the case. The graphics card has two DVI outputs, one HDMI and one DisplayPort output so you shouldn't have any trouble connecting to a monitor.

There's also room for expansion on the motherboard, with three accessible legacy PCI slots

reasonable 91.3% of the sRGB colour gamut but failed to impress with a contrast ratio of 423:1 and very narrow viewing angles, with a high degree of colour shift from the top to the bottom of the monitor.

The Microsoft Wired Desktop 400 keyboard and mouse are basic but functional and comfortable to use. The mouse doesn't have shoulder buttons, which are often useful for gaming and web browsing.

Overclockers' three-year warranty provides two years of collect and return cover and a further year of labour-only cover.

The Overclockers Titan Dagger is a decent gaming PC for buyers on a tight budget. It's a bit more expensive than similarly specified systems, though, and the peripherals leave just a little to be desired. There are much better systems elsewhere, however, such as Chillblast's Fusion Cyborg.

SPECIFICATIONS

PROCESSOR Dual-core 4.2GHz Intel Pentium G3258 (overclocked)
RAM 8GB
FRONT USB PORTS 1x USB3, 1x USB
REAR USB PORTS 2x USB3, 2x USB
TOTAL STORAGE 1TB hard disk
GRAPHICS CARD 2GB Nvidia GeForce GTX 750 Ti
DISPLAY 21.5in BenQ DL2215
OPERATING SYSTEM Windows 8.1
WARRANTY Two years collect and return, one year RTB
DETAILS www.overclockers.co.uk
PART CODE Titan Dagger



PALICOMP

AMD Nemesis Cube

£600 inc VAT • From www.palicom.co.uk

VERDICT

The case is a bit flimsy and future expansion is limited, but Palicom's AMD Nemesis Cube has a fast processor and graphics card

THE BITFENIX PRODIGY M that puts the 'Cube' in the AMD Nemesis Cube is one of the most distinctive budget cases on the market. The chassis has a squat design and an attractive front grille and matt black finish. It's not the easiest case to work in, but Palicom has done all the work so you don't have to.

While such a compact design may look great, there are some annoying quirks to take into account. First is a lack of insulation. Even when under very little load there's an audible whir coming from the various fans in the case, so you may wish to put this PC on the floor instead of on your desk. This lack of insulation also affects the system's temperature: even when idling the machine gives off a noticeable amount of heat from the sealed side panels. This is surprising considering there are four case fans in this machine: two intake fans at the front and underneath, and two exhaust fans on the top and at the rear.

The second issue is stability. Loaded down with components, the plastic legs on the case are a bit bendy and even lightly tapping the case will send it into a small wobble. You'd need a fairly powerful kick to knock it over, but it still feels a bit cheap and we'd have preferred more solid legs or feet.

All of this doesn't take away from the fact that the Nemesis Cube is a great-looking PC. Things are even better on the inside, with some great components making this computer a potent performer in both



processor- and graphics-intensive tasks. The processor is a quad-core AMD Athlon X4 860K 'Black Edition' chip overclocked from 3.7GHz to 4.2GHz, which is paired with 8GB of 1,600MHz Crucial Ballistix DDR3 memory.

The Athlon X4 860K is a decent-value processor and managed some good scores in our benchmarking test, largely thanks to it being overclocked to 4.2GHz. It performed best in the image-rendering test where it managed 76, dropping to 70 for video conversion and down to 58 in the tough multitasking test, giving it an overall score of 65. The Nemesis Cube certainly isn't underpowered, but you may want to leave it alone while it renders video.

With a little cash saved on the processor, Palicom has been able to drop in a great graphics card: a 2GB PowerColor AMD Radeon R9 270X. It's a mid-range piece of kit but it's capable of playing many modern games at relatively high settings without breaking too much of a sweat. It flew through our Full HD Dirt Showdown with an average frame rate of 74fps. The taxing Metro: Last Light Redux was almost playable at 24fps, and with SSAA switched off the game ran at a steady 45.5fps at Full HD resolution and Very High graphics settings. You can expect to run modern games smoothly at Medium to High settings on the Nemesis Cube.

Take off the side panel on the right of the case and you'll feast your eyes on one of the more interesting PC builds we've seen in a while. The shape of the case means that Palicom has had to mount the motherboard upside down, with the graphics card sitting right at the top of the build, ejecting its hot air straight into the top-mounted case fan. The 1TB hard disk, meanwhile, is mounted vertically and the PSU sits at the front of the case. It's neatly packaged, but if you're planning on upgrading in the future you'll have to familiarise yourself with the unusual design of the chassis. If you do take the side off the case, be aware that there are cables connecting the two 3.5mm audio jacks, USB ports and power

button. You'll need to disconnect them carefully before you fully remove the panel.

There's room for expansion: two free memory slots mean you can double your RAM, while there are six free SATA3 slots, although you'll never be able to fill them because there's only room in the case for one more 3½in hard disk. You'll struggle to fit extra expansion cards in the chassis, too; while there are PCI-E slots available, you'll be hard pressed to get all but the smallest components into the chassis.

Palicom has supplied a great monitor with the Nemesis Cube. The 24in Full HD Asus VS247HR doesn't have the prettiest design but its performance is good, especially considering the limited £600 budget and the power of the PC. We recorded sRGB gamut coverage of 94% and a contrast ratio of 1,298:1, with the added bonus of dark blacks (0.18cd/m²) and relatively wide viewing angles. If you don't already have a monitor, you'd do well to buy the Nemesis Cube with this screen. The supplied Nemesis keyboard and mouse are garishly lit and fairly unattractive (unless you love pulsating LEDs), but they work just fine and are comfortable to use.

Palicom's warranty lasts for three years and includes parts for the first year and labour for three. There's no collect and return element to this cover, though, so you'll have to pay for shipping if a problem develops.

The Palicom AMD Nemesis Cube is a terrific gaming PC with a distinctive design and well-rounded performance. The lack of space for future expansion hurts it slightly, as does the merely average warranty. Nonetheless, it's a great-value PC, although the Chillblast Fusion Cyborg is even better.



SPECIFICATIONS

PROCESSOR Quad-core 4.2GHz AMD Athlon X4 860K Black Edition (overclocked)
RAM 8GB
FRONT USB PORTS 1x USB3, 1x USB
REAR USB PORTS 2x USB3, 4x USB
TOTAL STORAGE 1TB hard disk
GRAPHICS CARD 2GB PowerColor Radeon R9 270X
DISPLAY 24in Asus VS247HR
OPERATING SYSTEM Windows 8.1
WARRANTY Three years RTB including one year parts
DETAILS www.palicom.co.uk
PART CODE NEM1

PC SPECIALIST

Invictus



£599 inc VAT • From www.pcspecialist.co.uk

VERDICT

A terrific graphics card and a good monitor make this a great gaming buy, but it lags behind in 2D work

IT'S OFTEN DIFFICULT to squeeze processing performance and graphical power into a budget PC, but PC Specialist has taken an interesting approach to its Invictus gaming PC to try and make the most out of both.

Inside the stylish ATX chassis you'll find a 2GB Palit GeForce GTX 960 graphics card and an overclocked Intel Pentium G3258 processor. While the Pentium brand might not exude power, this 20th anniversary chip is cheap and unlocked so can be overclocked to get great performance on a tight budget.

PC Specialist has ramped up the factory default 3.2GHz clock speed to an impressive 4GHz. With a large Titan heatsink and fan to keep this overclock stable, the processor was able to deliver decent results in our tough performance benchmarking tests. The high clock speed helped it fly through single-core tasks such as image processing, but only having two cores means multithreaded processes will suffer. In the image-crunching portion of our benchmarking test, the system scored an impressive 93. Things fell apart in the video-rendering and multitasking portions, with the performance dropping by more than half, giving the Invictus an overall benchmarking score of 55.

This shouldn't be an issue if you won't be doing processor-intensive tasks and it won't affect performance in most games, although complex titles such as simulations may suffer.

PC Specialist has chosen to use a single 8GB stick of RAM instead of two 4GB sticks. Because the motherboard has only two RAM

slots, your upgrade options are limited, but thanks to this slot remaining free, you can at least buy a single stick instead of two.

With the money saved on the processor, PC Specialist has gone all-out with the graphics card, which is up there with the most powerful £500 systems we've tested. The GeForce GTX 960 is Nvidia's latest mid-range GPU and is capable of impressive performance. The Palit card has 2GB of DDR5 memory, although unlike some of the other GTX 960 cards on the market, the fan doesn't stop spinning when the chip isn't under load. However, in terms of raw power, little at this price can touch it.

In the Dirt Showdown test it managed an excellent 74fps, while in the challenging Metro: Last Light Redux it scored 29fps. Switching off the GPU-hammering SSAA, we managed a much more stable 50.9fps. This PC is capable of playing the latest games at very high graphics settings with almost no problems.

Take a peek through the small window on the side of the case and you'll see lots of blue LEDs attached to the three 120mm case fans. There's one on the bottom, one at the rear and one on the top to keep air flowing when the PC is under load. Flashy additions may not be to everybody's tastes, but they look the part in this particular build.

Cable management isn't that tidy, with PC Specialist choosing not to route the cables behind the main portion of the case. Cables are kept tightly secured by ties, which is fine if you're not planning on upgrading but may be a pain if you choose to add an extra disk drive.

This is something you may wish to do as you only get a single 1TB Seagate hard disk. An SSD for quicker loading times and sprightlier performance would have been nice, but at this price, and considering the other components, this would have been a big challenge.

You get two USB ports on the front of the case: one USB3 and one USB sit either side of

3.5mm audio jacks. The Asus H81M-Plus motherboard has two USB3 ports at the rear alongside a further four USB ports, so there's plenty of room for expansion. The graphics card has two DVI outputs, one DisplayPort and one HDMI connector.

The bundled AOC e2250wda monitor is adequate, although being just 21.5in diagonally it's a little small for our tastes. Nonetheless, it's a Full HD panel that has surprisingly good colour performance and pretty wide viewing angles, so we can't complain. We measured it as being able to produce 88.8% of the sRGB colour gamut, while its contrast ratio of 1,046:1 is great for the price.

The Cooler Master Devastator is our favourite budget keyboard and mouse set. The full-size, backlit membrane keyboard has chunky keys and a satisfying typing action, while the five-button mouse looks stylish.

PC Specialist's three-year warranty is competitive, although it's only RTB cover meaning you'll have to handle shipping the PC back to the company if you have problems. Parts are covered for a year, so you'll have to pay for parts (but not labour) if a component fails outside of the first year.

The PC Specialist Invictus is a well-built, great-value gaming PC that whizzes through basic desktop tasks and powers through the latest games with ease. Our only concern is that the processor won't stand up to more intense tasks such as video editing and dealing with multiple video streams at once. If this isn't something you're planning on doing, though, this is a highly competent PC that will serve you well for several years.

SPECIFICATIONS

PROCESSOR Dual-core 4GHz Intel Pentium G3258 (overclocked)
RAM 8GB
FRONT USB PORTS 1x USB3, 1x USB
REAR USB PORTS 2x USB3, 4x USB
TOTAL STORAGE 1TB hard disk
GRAPHICS CARD 2GB Palit GeForce GTX 960
DISPLAY 21.5in AOC e2250wda
OPERATING SYSTEM Windows 8.1
WARRANTY Three years RTB, one year parts
DETAILS www.pcspecialist.co.uk
PART CODE Invictus



WIRED2FIRE

Diablo Ultima



£599 inc VAT • From www.wired2fire.co.uk

VERDICT

If you're not fussed about gaming performance, the Diablo Ultima is a superb choice

THE DIABLO ULTIMA is a well-balanced PC, with most of the expense going on the internal components rather than the outside. The Raijintek Arcadia case has a basic matt black paint scheme and honeycomb front grille. It's not exactly inspiring, but it does the job of insulating the internal components and keeping the noise down. It also leaves room for a little future expansion.

Open up the Diablo Ultima and you'll find a conventional PC build inside. Cables are neatly routed through the case's panels and most wires are kept tidy, aside from the PCI-E power connectors, which are left hanging loose next to the graphics card. There's one 120mm case fan at the rear.

The quad-core Intel Core i5-4460 processor runs at a base clock speed of 3.2GHz, Turbo Boosting to 3.4GHz when thermal conditions allow. It's cooled by a stock Intel heatsink and fan, and backed by 8GB of 1,600MHz DDR3 memory. It did well in our benchmarking tests, scoring 100 in the image-editing test, 93 for video conversion and an impressive 87 in the multitasking test. This is an extremely capable CPU perfect for processor-intensive tasks and is more than a match for simple desktop activities and web browsing. It's a great choice if you want to get things done quickly but on a budget.

Core i5 processors typically do well in our benchmarks, but their high price means other components in budget PC builds tend to be slightly downmarket. That's not the case here; Wired2Fire has installed a 2GB VTX3D AMD



Radeon R9 270, which is a decent mid-range graphics card. VTX3D has applied a modest overclock to the chip, upping the clock speed from 900MHz to 955MHz. Dirt Showdown at Ultra settings and 1,920x1,080 ran at a decent 62.2fps, while the more challenging Metro: Last Light Redux could only stutter along at 22.3fps. Turning off super sampling anti-aliasing brought this up to 41fps, which is easily playable while still looking fantastic.

There's a little room for expansion on the microATX Asus H81M motherboard, with two

The bundled LG 22MP55 monitor uses an IPS panel instead of the cheaper TN screens we normally see with lower-cost PCs. It has high contrast levels and deep blacks, but colour coverage and accuracy is poor with just 83.6% of the sRGB colour gamut covered. Colour coverage isn't everything, though, and if you're not too fussed about seeing faithfully recreated colours, it's perfectly adequate.

The bundled Octigen mouse is dinky but agreeable for those with smaller hands, but it doesn't have any extra buttons. The keyboard,

The quad-core Intel Core i5-4460 is a great choice if you want to get things done quickly but on a budget

PCI-E x1 slots available just below the graphics card. There are also two spare SATA2 connectors; the DVD-RW drive and 1TB Seagate Desktop hard disk have both been connected to the SATA3 ports. If you choose to buy an SSD at a later date, you should move the DVD-RW drive into one of the SATA2 slots so that your new SSD can take advantage of the higher speeds of SATA3.

There's no room for extra RAM, as both memory slots have been filled by 4GB sticks. If you want to double the memory to 16GB at a later date, you'll have to buy two 8GB sticks and ditch your existing memory; 8GB should be enough for most users right now, however.

The rear of the motherboard has two USB3 and four USB ports, while the case has two front-mounted USB ports, one of which is a USB3 connector. There are also three 3.5mm audio jacks at the rear of the case in addition to the two at the front. The graphics card has two DVI outputs as well as single HDMI and DisplayPort ports, so you'll easily be able to create a multi-monitor setup if you wish.

though, is awful, thanks to the tiny backspace key, spongy action and wafer-thin build. You should budget for a better keyboard because this one certainly won't cut the mustard.

Wired2Fire's standard warranty is one of the best in the business in terms of parts cover: you get two years of replacement parts and a total of three years labour cover. However, you'll have to pay to ship the PC back to base after the first month.

The Wired2Fire Diablo Ultima is a great all-rounder with a powerful processor and great mid-range graphics performance. That, in addition to its generous warranty, makes it a great buy. There are PCs with better graphics performance available at this price, but the Wired2Fire Diablo Ultima is unmatched in terms of CPU performance.



SPECIFICATIONS

PROCESSOR	Quad-core 3.2GHz Intel Core i5-4460
RAM	8GB
FRONT USB PORTS	1x USB3, 1x USB
REAR USB PORTS	2x USB3, 4x USB
TOTAL STORAGE	1TB hard disk
GRAPHICS CARD	2GB VTX3D Radeon R9 270
DISPLAY	22in LG 22MP55
OPERATING SYSTEM	Windows 8.1
WARRANTY	Three years RTB (two years parts, first 30 days collect and return)
DETAILS	www.wired2fire.co.uk
PART CODE	Diablo Ultima

YOYOTECH

Warbird RS6



£600 inc VAT • From www.yoyotech.co.uk

VERDICT

The Warbird RS6 has a powerful quad-core CPU and an SSD, but is let down by a sub-par monitor and keyboard

THE YOYOTECH WARBIRD RS6 takes its fans seriously, with three brightly lit 120mm intake and exhaust fans the most striking features of the PC's plain black EZCool case. It certainly looks the part, with some sharp lines and accents on the front of the chassis, and the red LEDs leaving you with no doubt that this is a PC for someone who likes to show off, but is still on a budget.

Take the side off the case and you'll see a tidy and simple internal setup. The bundle of wires that leads to the two side-mounted case fans is less attractive, although you probably won't spend much time looking into the case once you're up and running. You have to open the case to remove the protective packaging, but we also had to open the other side of the case because a cable had been routed into the blades of the front intake fan, stopping it from spinning. It's a minor error, but with custom PC builds, attention to detail is key.

The front of the case has two USB3 ports and two 3.5mm audio jacks, with a further four USB3 ports, two USB ports and three 3.5mm audio jacks at the rear. The graphics card, meanwhile, has two DVI outputs, a single DisplayPort and an HDMI output.

YoyoTech has chosen a mid-range processor for this machine, installing a quad-core 3.1GHz Intel Core i5-4440 processor. It's not as fast as some of the other Core i5 chips in similarly priced machines, but unless you're going to be performing very intensive media tasks you probably won't notice the difference.



Its results in our benchmarking tests were respectable. It managed an overall score of 87, peaking at 97 in the image-editing test and managing 87 in the video-editing and 84 in the multitasking tests. Things ran smoothly in all of these tests, with the processor and case fans remaining relatively quiet throughout.

Graphics processing is handled by the 2GB XFX AMD R7 260X that sits in the single PCI-E x16 slot on the motherboard. It's not the most powerful graphics card in AMD's range but it can handle most recent games in Full HD at moderately challenging settings. Metro: Last Light Redux wasn't playable with the settings turned all the way up, with the Warbird RS6 managing just 13.3fps at Very High settings in Full HD with SSAA turned on. Switching to High settings and disabling SSAA improved things hugely, with a stable 35fps making for a very playable game. Dirt Showdown at Ultra settings in Full HD was a smooth 49.1fps.

YoyoTech has generously included a 120GB Patriot Blaze alongside the 1TB Seagate Desktop HDD, so quick boot times and speedy access to your bigger files is guaranteed. You may wish to upgrade to a larger SSD if you have lots of games or large files you access regularly, but the 120GB model is great for boosting startup and application load times.

The Warbird RS6 doesn't have a huge amount of room for expansion. The MSI H81M-E34 motherboard has been mostly filled by YoyoTech's components, with both RAM slots, three of the four SATA connectors and the only PCI-E x16 slot already taken. This realistically leaves you room for another hard disk if you need it and a single PCI-E x1 expansion card such as a TV tuner or wireless card.

The bundled monitor is a 24in AOC E2470SWHE. This is a Full HD panel, although it uses TN technology instead of IPS, so images aren't quite as pleasant to look at as they are on similar IPS screens. We were a little concerned when we saw a fair

degree of motion blur with fast-moving objects moving both horizontally and vertically, so this screen probably won't suit twitchy gamers. Still, it covers 90.9% of the sRGB colour gamut and has a good contrast ratio of 994:1 so we can't complain too much.

The bundled Zalman mouse is perfectly adequate and looks stylish, but the Powercool keyboard is atrocious. It has patchy coloured backlighting apparently able to light up in red, blue and green, but our model could only manage blue and red, with the green setting instead switching the backlight off entirely. It was a pain to type on as well: the keys are spongy and the keyboard itself doesn't have enough elevation. In short, you should avoid this keyboard and choose something else when configuring your system.

YoyoTech's warranty is good but not exceptional: you get three years of labour cover and one year of parts, but after the first month you'll need to pay for shipping back to the company as it's an RTB policy rather than a more generous collect-and-return agreement. You can upgrade to a Gold warranty for £40, which nets you a year of collect and return and three years of parts cover, or you can pay £70 for Platinum cover, which gets you three years of parts cover and free courier collection.

The YoyoTech Warbird RS6 is a good-value and well-balanced PC that includes an SSD and a decent monitor. Performance is strong for the money, and if that's all you're after then this is a great choice. Our only real concern is the lack of flexibility for future upgrades, but if that doesn't bother you, the YoyoTech Warbird RS6 is a good choice.



SPECIFICATIONS

PROCESSOR Quad-core 3.1GHz Intel Core i5-4440

RAM 8GB

FRONT USB PORTS 2x USB3

REAR USB PORTS 4x USB3, 2x USB

TOTAL STORAGE 120GB SSD, 1TB hard disk

GRAPHICS CARD 2GB XFX Radeon R7 260X

DISPLAY 24in AOC E2470SWHE

OPERATING SYSTEM Windows 8.1

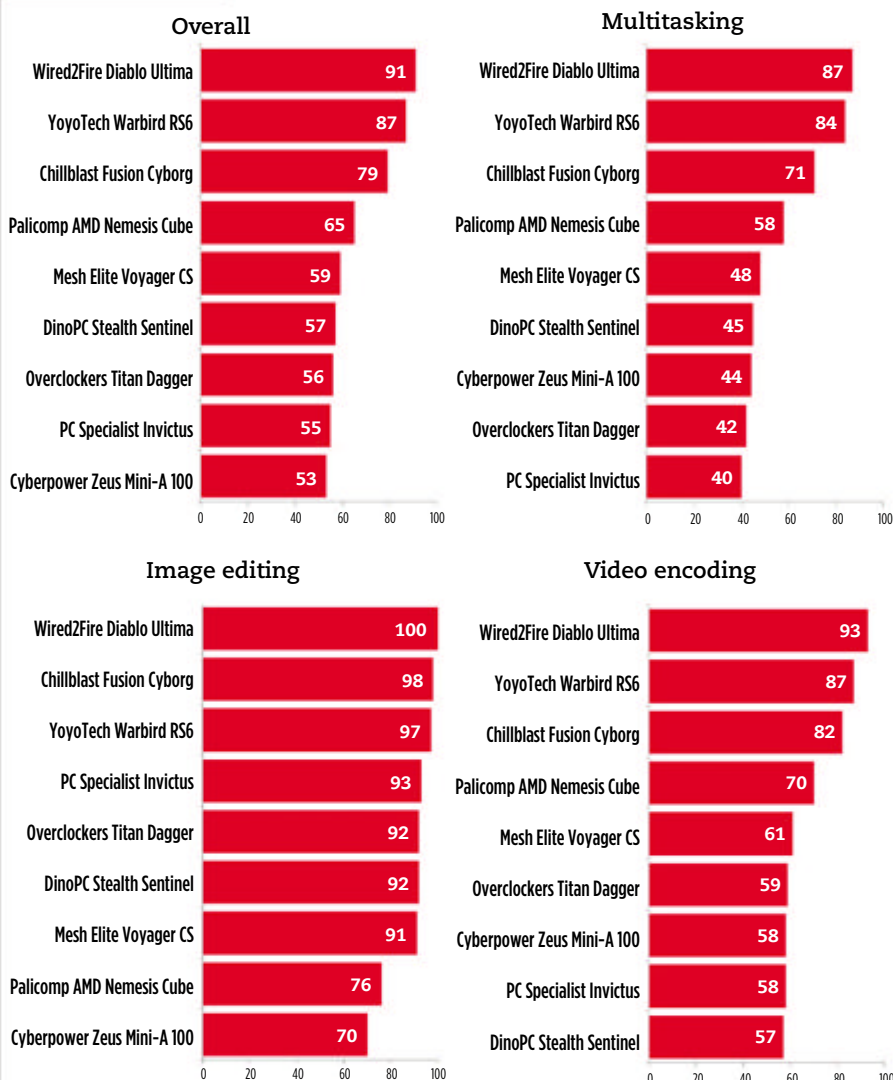
WARRANTY Three years RTB including one year parts and first 30 days collect and return

DETAILS www.yoyotech.co.uk

PART CODE Warbird RS6

BENCHMARKS

2D performance



Our benchmark suite allows us to compare Windows, Mac OS X and Linux PCs. The tests use open-source applications to gauge a PC's performance, and comprise image-editing, video-editing and multitasking elements. These scores are combined to produce the overall score.

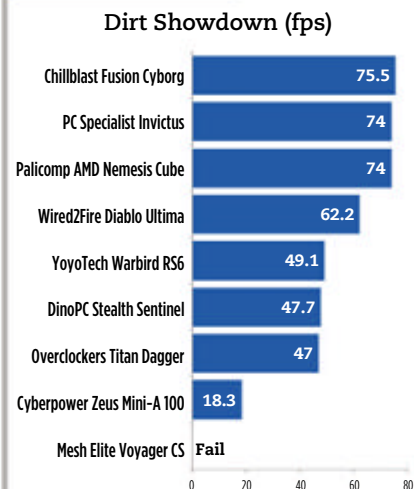
Our reference PC is fitted with an Intel Core i5-3570K processor and 4GB

of DDR3 RAM. We have normalised all its results to 100, which makes it easy to draw comparisons. We use the same tests in all our reviews.

You can download the tests for free from <http://bit.ly/shopperbenchmarks>.

SETTINGS We run our application tests at native resolution
WEB <http://bit.ly/shopperbenchmarks>

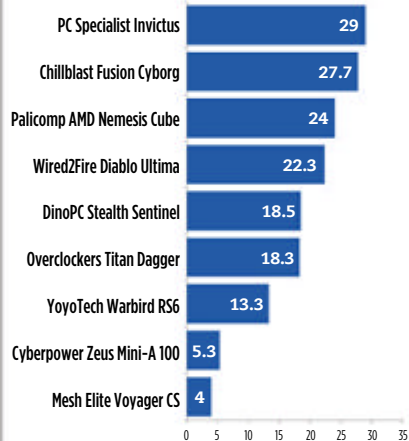
3D performance



Dirt Showdown is a cracking racing game that requires relatively modest graphics hardware. We look for an average frame rate of 30fps to consider it playable.

SETTINGS 1,920x1,080 resolution, 4x AA, Ultra settings

Metro: Last Light Redux (fps)



Metro: Last Light Redux is a gorgeous game that will challenge all but the best graphics cards at maximum graphics settings. Its built-in benchmark will stress test a graphics card to its limits.

SETTINGS 1,920x1,080 resolution, SSAA on, Very High settings

VERDICT

In one of the most competitive PC group tests we've ever run, picking an overall winner has been tough. The Chillblast Fusion Cyborg just wins out thanks to its terrific all-round performance and generous warranty.

Just a whisker behind, though, are Palicomp's AMD Nemesis Cube and the PC Specialist Invictus, both of which have a slight edge in gaming performance but less powerful CPUs.

PALICOMP AMD Nemesis Cube

★★★★☆

COMPUTER SHOPPER
RECOMMENDED



CHILLBLAST Fusion Cyborg

★★★★★

COMPUTER SHOPPER
BEST BUY



BEST BUY					
CHILLBLAST		CYBERPOWER		DINOPC	
Fusion Cyborg		Zeus Mini-A 100		Stealth Sentinel	
★★★★★		★★★★☆		★★★★☆	
CORE SPECS					
Processor	Quad-core 3.2GHz Intel Core i5-4460	Quad-core 3.7GHz AMD A10-7850K	Dual-core 3.6GHz Intel Core i3-4160	Dual-core 3.6GHz Intel Core i3-4160	
Processor socket	LGA1150	FM2+	LGA1150	LGA1150	
RAM	8GB	8GB	8GB	8GB	
Memory type	1,600MHz DDR3	1,600MHz DDR3	1,600MHz DDR3	1,866MHz DDR3	
Maximum memory	32GB	16GB	16GB	16GB	
Motherboard	Gigabyte GA-B85M-DS3H	MSI A88XI AC	Gigabyte GA-H81M-S2H	MSI Z97I AC	
Motherboard chipset	Intel B85	AMD A88	Intel H81	Intel Z97	
PORTS AND EXPANSION					
Front USB ports	1x USB3, 1x USB	1x USB3, 1x USB	2x USB3	2x USB3	
Rear USB ports	2x USB3, 4x USB	2x USB3, 4x USB	4x USB3, 2x USB	4x USB3, 2x USB	
Other ports	1x PS/2	1x PS/2	2x PS/2	1x PS/2	
Networking	1x 10/100/1,000 Ethernet	1x 10/100/1,000 Ethernet	1x 10/100/1,000 Ethernet	2x 10/100/1,000 Ethernet, 802.11ac Wi-Fi	
Case type	MicroATX	Mini-ITX	ATX	Mini-ITX	
Case size (HxWxD)	427x189x364mm	330x112x442mm	430x200x471mm	290x351x277mm	
PCI (free)	0	0	0	0	
PCI-E x1 (free)	2 (1)	0	2 (1)	0	
PCI-E x16 (free)	1 (0)	1 (1)	1 (0)	1 (1)	
Serial ATA (free)	4x SATA3 (3)	4 (2)	4 (3)	4 (1)	
Memory slots (free)	4 (2)	2 (0)	2 (0)	2 (0)	
Drive bays 2½in (free)	2 (1)	0	4 (3)	3 (1)	
Drive bays 3½in (free)	2 (1)	2 (1)	4 (3)	3 (1)	
Drive bays 5¼in (free)	1 (1)	1 (0)	2 (2)	1 (0)	
STORAGE					
Total storage	1TB SSHD (8GB SSD cache)	1TB hard disk	240GB SSD	120GB SSD, 1TB hard disk	
Memory card reader	None	None	None	None	
Optical drive type	None	DVD-RW	None	DVD-RW	
GRAPHICS					
Graphics card	2GB PowerColor Radeon R9 270X	Integrated AMD Radeon R7 200-series	2GB Zotac GeForce GTX 750 Ti	Integrated Intel HD Graphics 4400	
Graphics/video ports	2x DVI, HDMI, DisplayPort	DVI, HDMI, VGA	2x DVI, 1x Mini HDMI	DVI, DisplayPort, HDMI	
SOUND					
Sound card	Integrated	Integrated	Integrated	Integrated	
Sound card outputs	3x 3.5mm audio output	3x 3.5mm audio output	3x 3.5mm audio output	6x 3.5mm audio output, optical S/PDF	
Speakers	None	None	None	None	
DISPLAY					
Display	22.5in AOC e2250wda	21.5in AOC E2250SWDN	24in Iiyama ProLite GE2488HS-B1	22in BenQ GW2255	
Native resolution	1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080	
Inputs	DVI, VGA	DVI, VGA	DVI, HDMI, VGA	DVI, VGA	
OTHER HARDWARE					
Keyboard	Zalman ZM-K350M	Cooler Master Devastator	Logitech K120	Microsoft Wired Desktop Keyboard 600	
Mouse	Zalman ZM-M300	Cooler Master Devastator	Logitech M120	Microsoft Wired Desktop Mouse 600	
Extras	None	None	None	None	
SOFTWARE					
Operating system	Windows 8.1 or Windows 7	Windows 8.1	Windows 8.1 or Windows 7 (£2 extra)	Windows 8.1 or Windows 7 (£39 extra)	
Operating system restore option	Windows 8.1 recovery	Windows 8.1 restore	Windows 8 restore	Windows 8 restore	
BUYING INFORMATION					
Warranty	Two years collect and return with parts, three years labour-only RTB	Three years RTB including two years of parts	Three years RTB including one year of parts cover, first 30 days collect and return	One year collect and return, two years parts cover, lifetime labour	
Price including delivery (inc VAT)	£600	£599	£599	£599	
Price excluding monitor (inc VAT and delivery)	£500	£499	£499	£499	
Supplier	www.chillblast.com	www.cyberpowersystem.co.uk	www.dinopc.com	www.meshcomputers.com	
Details	www.chillblast.com	www.cyberpowersystem.co.uk	www.dinopc.com	www.meshcomputers.com	
Part code	Fusion Cyborg	Zeus Mini-A 100	Stealth Sentinel	Elite Voyager CS	

OVERCLOCKERS	RECOMMENDED PALICOMP	PC SPECIALIST	WIRED2FIRE	YOYOTECH
Titan Dagger ★★★★☆	AMD Nemesis Cube ★★★★☆	Invictus ★★★★☆	Diablo Ultima ★★★★☆	Warbird RS6 ★★★★☆
Dual-core 4.2GHz Intel Pentium G3258 (overclocked)	Quad-core 4.2GHz AMD Athlon X4 860K Black Edition (overclocked)	Dual-core 4GHz Intel Pentium G3258 (overclocked)	Quad-core 3.2GHz Intel Core i5-4460	Quad-core 3.1GHz Intel Core i5-4440
LGA1150	FM2+	LGA1150	LGA1150	LGA1150
8GB	8GB	8GB	8GB	8GB
1,600MHz DDR3	1,600MHz DDR3	1,600MHz DDR3	1,600MHz DDR3	1,600MHz DDR3
16GB	32GB	32GB	16GB	32GB
Asus H81-Plus	Asus A88XM-Plus	Asus H81M-Plus	Asus H81M-Plus	MSI H81M-E34
Intel H81	AMD A88X	Intel H81M	Intel H81	Intel H81
1x USB3, 1x USB	1x USB3, 1x USB	1x USB3, 1x USB	1x USB3, 1x USB	2x USB3
2x USB3, 2x USB	2x USB3, 4x USB	2x USB3, 4x USB	2x USB3, 4x USB	4x USB3, 2x USB
2x PS/2	2x PS/2	2x PS/2	2x PS/2	2x PS/2
1x 10/100/1,000 Ethernet	1x 10/100/1,000 Ethernet	1x 10/100/1,000 Ethernet	1x 10/100/1,000 Ethernet	1x 10/100/1,000 Ethernet
ATX	MicroATX	ATX	ATX	Mid-tower
429x185x470mm	359x250x404mm	487x451x212mm	430x455x200mm	400x415x175mm
3 (3)	1 (1)	0	0	0
1 (1)	1 (0)	3 (3)	3 (2)	2 (1)
1 (0)	2 (0)	1 (0)	1 (0)	1 (0)
4 (2)	8 (6)	2x SATA3 (1), 2x SATA2 (1)	4 (2)	2x SATA3 (0), 2x SATA2 (1)
2 (0)	4 (2)	2 (1)	2 (0)	2 (0)
3 (3)	2 (1)	2 (1)	1 (1)	1 (0)
3 (2)	2 (1)	2 (1)	3 (2)	5 (4)
2 (1)	1 (0)	9 (7)	2 (1)	3 (2)
1TB hard disk	1TB hard disk	1TB hard disk	1TB hard disk	120GB SSD, 1TB hard disk
None	None	None	None	None
DVD-RW	DVD-RW	DVD-RW	DVD-RW	DVD-RW
2GB Nvidia GeForce GTX 750 Ti	2GB PowerColor Radeon R9 270X	2GB Palit GeForce GTX 960	2GB VTX3D Radeon R9 270	2GB XFX Radeon R7 260X
2x DVI, HDMI, DisplayPort	2x DVI, DisplayPort, HDMI	2x DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort
Integrated	Integrated	Integrated	None	Integrated
3x 3.5mm audio output	3x 3.5mm audio output	3x 3.5mm audio output	3x 3.5mm audio output	3x 3.5mm audio output
None	None	None	None	None
21.5in BenQ DL2215	24in Asus VS247HR	21.5in AOC e2250wda	22in LG 22MP55	24in AOC E2470SWHE
1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080
DVI, VGA	DVI, HDMI, VGA	VGA, DVI	HDMI, VGA	2x HDMI, VGA
Microsoft Wired Keyboard 400	Nemesis Kane Pro	CoolerMaster Devastator	Octigen Multimedia	Powercool Multimedia Keyboard
Microsoft Wired Mouse 400	Nemesis Kane Pro	CoolerMaster Devastator	Octigen 3D	Zalman ZM-M201
None	None	None	None	None
Windows 8.1 or Windows 7 (£7 extra)	Windows 8.1 or Windows 7	Windows 8.1	Windows 8.1 or Windows 7 (£3 extra)	Windows 8.1 or Windows 7 (£36 extra)
Windows 8 restore	Windows 8.1 restore	Windows 8.1 restore	Windows 8 restore	Windows 8.1 recovery
Two years collect and return followed by one year RTB	Three years RTB including one year parts cover	Three years RTB (one year parts cover)	Three years RTB (two years parts, first 30 days collect and return)	Three years RTB including one year parts, first 30 days collect and return
£622	£600	£599	£599	£600
£532	£500	£499	£499	£500
www.overclockers.co.uk	www.palicomp.co.uk	www.pcspecialist.co.uk	www.wired2fire.co.uk	www.yoyotech.co.uk
www.overclockers.co.uk	www.palicomp.co.uk	www.pcspecialist.co.uk	www.wired2fire.co.uk	www.yoyotech.co.uk
Titan Dagger	NEM1	Invictus	Diablo Ultima	Warbird RS6



EYES ON THE ROAD

Dashboard cameras

A dashcam can help you prove your case after a bump and may even reduce your insurance premiums. We pick up eight devices and take them for a spin

CONTENT REVIEWS

Page 94

GOPRO Hero4 Silver

Page 94

MIO MiVue 518

Page 95

MIO MiVue 538 Deluxe

Page 95

NEXTBASE In-Car Cam 101 Go

Page 96

NEXTBASE In-Car Cam 402-G

Page 96

RAC Digital CarCam 01

Page 97

RAC Digital CarCam 02

Page 97

ROADHAWK DC-2

WHETHER YOU WANT to save a few pounds on your insurance premiums (see page 101), protect against rogue drivers or simply keep a record of your journeys, a dashcam is a valuable asset. These devices are increasingly popular fixtures on drivers' windscreens, with wide-angle HD cameras that can see almost everything the driver can, and often provide crucial evidence of who or what was to blame for a road accident.

We've tested seven dedicated dashcams this month, as well as the popular GoPro Hero4 Silver action cam to see whether it can

double as another eye on the road. We've also tested two smartphone apps to find out if you even need to bother investing in dedicated camera hardware.

POWERING UP

All the dedicated dashcams we tested start recording as soon as you plug in their cigarette lighter chargers, which eliminates any risk that you'll forget to press the record button before you set off. Almost all the devices come with built-in rechargeable batteries too, although none except the GoPro action cam is designed to be operated on battery power. In the other models, the battery is simply there

bump, for instance – but you can usually alter the sensitivity in the device's settings.

VIDEO QUALITY

Most of the dashcams in this test record footage at Full HD resolution (1,920x1,080) and 30 frames per second, although two of the cheaper devices are limited to 720p (1,280x720). The difference in resolution is very noticeable, especially when it comes to spotting details such as the number plates of other vehicles. Video quality differs significantly even among the devices that record at Full HD, so it's important to read the individual reviews rather than choosing a dashcam based solely on its resolution.

Dashcams are equipped with impact sensors, and if the camera detects a heavy shake or sudden jolt, it will protect that recording, ensuring it's not overwritten

as a backup so the camera can continue to record if the car engine cuts out after an accident, for example. HD video recording is a battery-intensive business, and the small backup batteries in these devices will last for only a few minutes on a full charge, so (despite what some of the marketing images portray) you'll need to plug in the charger.

If you already use your car's cigarette lighter to charge a smartphone or power a satnav, you may need to invest in a high-powered dual-USB charger, such as the Belkin F8J109btBLK (£20 including VAT from www.currys.co.uk). This should provide enough power to keep both devices going, although you may need a longer USB cable if you're to position your dashcam in the safest position (see right).

All the dedicated dashcams record footage in short segments – usually three minutes, but you can often change this in the device's settings. As HD footage is fairly storage-intensive, a 4GB or 8GB memory card could conceivably fill up in a single journey, so in order to keep going, dashcams automatically overwrite the oldest three-minute clip when the memory card reaches its capacity.

This could obviously lead to the risk that crucial footage is overwritten, so the cameras have built-in systems that make sure no critical clips are deleted. The dashcams are equipped with impact sensors, and if the camera detects a heavy shake or sudden jolt, it will protect that recording, ensuring it's not overwritten even if you continue your journey. There's also an emergency button that you can press to protect recordings manually – say, if a motorist strikes a pedestrian in front of you in an accident that doesn't directly involve your vehicle. The automatic accident-detection sensors can occasionally be a little over-zealous – some triggered emergency recordings when we clattered over a speed

All the dashcams give you the option to lower the resolution to save on memory card space. Unless you desperately want to capture a long journey in its entirety we wouldn't recommend this, as the reduction in quality could mean you miss a crucial piece of evidence in an accident investigation. It's better to invest in a higher-capacity card if you're concerned about running out of storage. Make sure you go for a Class 10 microSD card for recording Full HD video footage, or the card might not be fast enough to capture the video smoothly.

Each dashcam has an internal mic that records the audio in the car. The benefit of this is pretty negligible, and many devices allow you to switch the mic off. Most also

offer a facility for taking still photos, which could be handy if you need to send photos of crash damage to your insurance company – although the quality of shots from these cameras is often inferior to that of a decent smartphone camera, and the battery might run out before you've even had a chance to take your photos.

GPS AND EXTRA FEATURES

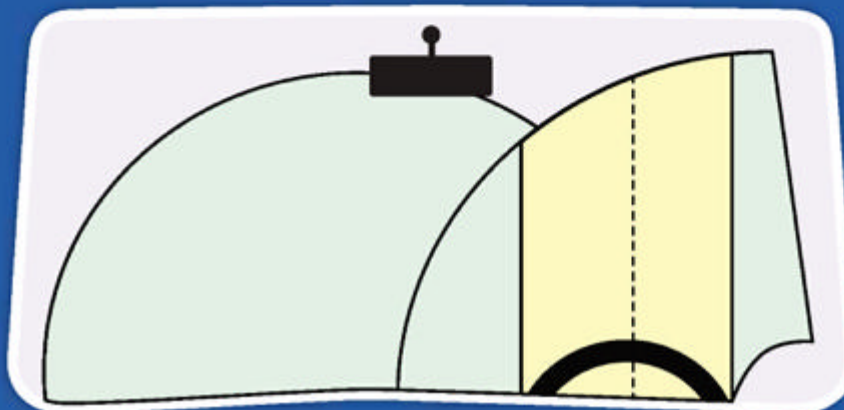
These cameras offer little in the way of extra features. The Mio MiVue 538 Deluxe provides speed camera alerts. Several devices come with software that lets you manage the recordings and plot your journeys on a map using data captured by the integrated GPS chip (or in one case an external module).

The GPS in these devices not only plots your precise position but also records the speed at which you're travelling, often embedding this information in the video. This could be both a blessing and a curse. If it proves you weren't speeding when an accident occurred, all well and good, but if you crept over the limit, that information will be captured on camera, potentially incriminating you. Most cameras provide the option to switch the GPS data off.

This isn't the only legal consideration, as the law is hazy when it comes to use of dashcams. The Road Vehicles (Construction and Use) Regulations 1986 state that it's against the law for drivers to see a "camera" or "computer" screen that isn't informing them about the state of the vehicle or its location (as satnavs do), or assisting them to see part of the road. It's hard to argue that a dashcam meets those criteria, although the law was plainly conceived before such devices existed. The Department for Transport was unable to comment on the use of dashcams as we went to press. You can read more on the legal and insurance aspects on page 101.

Where can I mount my camera?

There are no hard and fast rules about where on your windscreen you're allowed to place your camera. As the diagram below shows, however, most dashcam manuals state that the device shouldn't intrude more than 4cm into the pink zone or 1cm into the red zone of your screen.



GOPRO Hero4 Silver + Car Suction Mount



£279 inc VAT • From www.jessops.co.uk

VERDICT

The Hero4 is the perfect choice for motorsport and track day enthusiasts, but too impractical to use as a day-to-day dashcam

THE GOPRO HERO4 isn't really a dashcam, but as it's arguably the best – and certainly the best-known – action cam on the market, many people may be wondering if it could double up as a dashboard model. The answer is yes, but with several caveats.

The most obvious problem is that the Hero4 isn't easy to mount in a car, even with its dedicated suction-cup holder. This is because the suction cup is designed to attach to the outside of cars and motorbikes travelling at speeds of up to 150mph. We don't doubt its ability to grip, but with questions over the safety and legality of mounting a camera on the outside of a car on public roads, we opted to fix it internally. It wouldn't stick to our curved dashboard, but it sucked firmly on to the windscreen with the camera mounted upside down. That's not a big problem, as you can flip the footage with the accompanying editing software.

The other problem is the GoPro's battery life. When shooting in 1080p SuperView

mode, the most you can expect from the battery is around 90 minutes, although it was closer to 60 minutes in our tests. You can't fit a charger because the camera is completely encased (we were able to construct a Blu Tack mount that let us connect a USB charger, but we wouldn't recommend it.) This means it's not the ideal device for recording your typical motorway slog.

The camera is far better suited to capturing the action on track days or other specialist motoring events. The daytime footage we captured with the GoPro is stunning, and was certainly head and shoulders above that of any of the dedicated dashcams. The 1080p SuperView produces dynamically stretched footage in a 16:9 aspect ratio for a perfectly sharp image that spans the entire road. There's no distortion at speed because the footage is captured at 60fps. Colours and contrast are well balanced, and video feels utterly immersive. It's less impressive after dark, even when using the



low-light recording mode, and footage looked disappointingly dank, albeit with lots of detail.

The screen on the back of the Hero4 stays on for a few seconds when you start recording, but then switches itself off, so you won't be distracted if you're bombing round a corner at Brands Hatch. A red LED on the back indicates that the camera is recording, and all the menu buttons and touchscreen are fully accessible through the clear plastic housing when you come to a stop.

The tiny touchscreen on the back of the device is responsive and incredibly sharp for its size, allowing you to review your footage as soon as you've shot it. This takes its toll on the limited battery life, though.

If you're looking for a dashcam to record your daily commute up and down the M1, the GoPro Hero4 isn't even a consideration, but anyone who wants to capture high-quality footage as they thrash their car around a race track should look no further.

MIO MiVue 518



£90 inc VAT • From www.halfords.co.uk

VERDICT

The compact MiVue 518 is a bargain Full HD dashcam with great software

THIS IS THE only sub-£100 dashcam we've tested that offers Full HD recording. You'll have to buy a memory card to store all that HD footage, though, as the MiVue 518 comes with only the bare essentials in the box: the dashcam, the suction cup, the charger and a paper manual. There isn't even a Mini USB cable to help you transfer your footage, so you'll have to provide your own.

Unlike its sub-£100 rivals from RAC and Nextbase, the MiVue 518 has software that you can download to manage your recordings. The MiVue Manager application is excellent, beating even the applications supplied with the premium cameras. A month-view calendar in the top-right corner of the screen lets you flick to recordings from a particular day, and videos can be quickly filtered to list only accident recordings, for example. The car's location is tracked on a Google Map in the bottom of the screen, and sensors reveal the direction of impact in an accident. You can even use the software to upload videos to a

YouTube account, which could be handy for sending evidence to insurance companies or the police.

Video from the MiVue 518 is decent enough. It doesn't quite hit the super-smooth heights of the Roadhawk DC-2 or GoPro's footage, and there was notable distortion in the bottom of the frame when the car was moving at speed, but the video was more than good enough for us to make out the number plates of adjacent cars on the motorway. Night-time footage is grainier but still gives plenty of detail, and there was none of the over-exposure that led to loss of detail such as number plates in night footage from other dashcams. We also like the way Mio embeds the device name, speed and GPS data into the video file, so you don't have to install the accompanying software if you don't want to.

The camera is thoughtfully designed. It's small, so it won't obstruct your view too much, and has four buttons at the foot of the screen, the function of which changes



depending on which menu screen you're accessing. This makes the device easy to operate.

The LCD screen can be set to black out in as little as 10 seconds after recording starts, so the device shouldn't become a distraction for the driver. We only wish this standby mode was active by default rather than being tucked away in the System settings.

The MiVue 518 has collision sensors that protect recordings from being overwritten if the device detects a sudden impact, although the two MiVue devices in our tests were the only models to be consistently triggered by speed bumps at their default settings. Thankfully, you can alter the sensitivity of the sensors to reduce the risk of false positives.

We were highly impressed with the Mio MiVue 518 dashcam. It may not provide the greatest video quality but it's by far the best budget device we've tested and doesn't have any serious shortcomings. It wins a Best Buy award.

MIO MiVue 538 Deluxe



£150 inc VAT • From www.halfords.com

VERDICT

A good-quality compact dashcam with built-in speed camera alerts, but the cheaper MiVue 518 is better value



IF YOU'RE GOING to append the word Deluxe to a product, it had better have something to back it up. In this respect, the MiVue 538 has a feature that's unique among the dashcams in this test: speed camera alerts.

Mio promises that the camera will be supplied with free safety camera updates for "the lifetime of your device", and in our tests it certainly gave us plenty of advance warning of all the cameras we know of in the Brighton area. The screen shows your current speed as well as the speed limit, giving you plenty of time to slow down if you stray over the limit. The default volume level is pretty low, though, and is unlikely to be heard over a radio, so turn up the volume to make sure you hear the warning pings. The speed camera warnings override the setting that blanks the screen during recordings, and the screen goes blank again when the warning is no longer relevant.

These speed camera alerts will almost certainly mean you have to keep the MiVue 538 Deluxe in view rather than tucked behind

the rear-view mirror. To this end, the compact camera and suction cup cause minimal obstruction to the driver's view – much less than most satnav units or smartphones when stuck on your windscreen. However, the charger's USB connector juts upwards from the unit's right-hand side, making it awkward to put the device low on the windscreen, as the cable can dangle in front of the display.

Physically, the MiVue 538 Deluxe is almost identical to the cheaper MiVue 518. It has an all-glass front rather than a plastic bezel, and there's a Mini HDMI port for connecting to a TV or monitor to play your footage, but otherwise there's little to choose between them. Recording performance is very similar. If anything, the MiVue 538 Deluxe showed a little more distortion than the MiVue 518, with bright sunlight creating blocky artefacts, but both perform well in all light conditions.

Like the MiVue 518, the 538 can be set to blank its screen automatically after a few seconds to avoid distractions. The camera's

2.4in screen is reasonably bright and just about sharp enough for you to make out detail if you need to replay incidents at the roadside. The battery is weak, however, barely giving us a minute to snap some photos before conking out. That's partly because the Mio's devices lack a dedicated stills camera mode – they simply take freeze frame snaps as the video rolls, which consumes a lot of battery power. The photos are good enough for basic damage shots, but the MiVue 538 Deluxe's images aren't as high-resolution as shots from other dashcams we've tested.

The only other deluxe qualities of the MiVue 538 are an 8GB memory card (absent from the MiVue 518) and a carry pouch. We're not sure the MiVue 538 Deluxe does enough to justify the extra £46 over the MiVue 518, as we could easily live without the case, and memory cards of this capacity cost less than £10. It's a good camera, but don't pay extra for the MiVue 538 Deluxe unless you're desperate for the speed camera alerts.

NEXBASE In-Car Cam 101 Go



£60 inc VAT • From www.audiovisualworld.co.uk

VERDICT

A no-frills budget camera that won't block your view, but it doesn't produce the clearest video we've seen



THE 101 GO is the cheapest dashcam on test, and also one of the smallest. The dinky unit and its equally compact suction cup holder will do little to obstruct your view, even if you ignore the safety advice to place it behind your rear view mirror. It's the lightest camera we've seen, too, weighing just 56g, so there's little prospect of it falling off the windscreen when you go over a speed bump.

The camera could hardly be easier to operate. It starts recording the moment you plug in the charger, and the menus are easy to navigate with the four substantial buttons on the front. A sensor detects impacts automatically and protects recordings made around that incident, but you can press the incident button on the front of the device to make sure your footage is preserved.

The 101 Go's tiny screen isn't particularly bright. It's fine for browsing the menus, but if you're trying to replay an incident, you won't be able to see much in broad daylight. The screen's limited resolution also gives you little

hope of picking out details such as vehicle number plates. The camera turns off its screen after a few seconds, so you won't be distracted.

No software is supplied with the 101 Go, but you can easily browse the videos and photos stored on the camera if you plug the device into a PC with a USB cable. Protected recordings have the letters PRO at the beginning of their filename, making it easy to find footage of accidents.

The camera's video quality is among the weakest in the group. This is one of only two dashcams we've tested that limits video resolution to 720p at 30fps, and the captured footage looks blocky, heavily compressed and lacking in detail. Even when crawling past parked cars at around 10mph, it's impossible to pick out number plates in broad daylight, and the camera's field of view is one of the narrowest we've seen.

These problems were even worse at night. On unlit roads, it was tricky to make out what

was going on and there was lots of distortion on the video that reminded us of old VHS security camera footage. The footage would probably be just about good enough to give your insurance company a view of an accident, but you wouldn't want to rely on it if you needed to identify a number plate, for example.

The photo quality isn't too shabby. If you had to take snaps of your car after a daytime accident, the 101 Go would suffice. Photos showed reasonable levels of detail, although the shots we took on a cloudy afternoon veered towards over-exposure, so the camera might struggle in very bright conditions.

The 101 Go just about covers the basics and should suffice if you want a safety net to prove that you didn't cause an accident. There's no GPS for location or speed data and no PC software, however, and the video quality is basic. This camera may be inexpensive but we'd rather find the extra £30 for the Mio MiVue 518.

NEXTBASE In-Car Cam 402-G Professional



£141 inc VAT • From www.nigelohara.com

VERDICT

A widescreen camera with decent video quality, but the Nextbase 402 has a couple of irritating flaws that keep it from an award

THE NEXTBASE 402-G is designed to tuck behind a rear-view mirror to keep it out of the driver's field of vision. That's all well and good, but some features – such as the driver fatigue warnings – require you to see the screen, so we're not convinced that this is the best place for it. You can choose to blank out the screen while driving or display a speedometer and compass, which seems faintly pointless.

The 402-G isn't just a step up in screen size from its stablemate, the 101 Go – it's also a step up in resolution. The 402-G captures Full HD video at 30fps and the difference is obvious. There was a little distortion in fast-moving footage, but the picture quality is much cleaner. In daylight footage you can make out the number plates of cars travelling in the opposite direction while driving at 50mph if you use PC software such as VLC to play back the video frame by frame.

Night footage is reasonably clear too. You'll have no problem identifying the cause of an accident, although number plates tend

to be a little overexposed and hard to make out. The 402-G doesn't match the video quality of the Roadhawk DC-2 or GoPro Hero4 but it's good enough for most purposes.

The 402-G comes with a CD containing the company's Driving Recorder Player software, which you can also download from the company's website. This uses GPS data from the dashcam to plot your position on a Google Map as you play back the footage, and also reveals other crucial data, such as the speed at which you were travelling and the direction of impact (according to built-in motion sensors), which could be extremely helpful in piecing together an accident investigation. You can even enter your number plate into the device and have that embedded in the video, which might be useful for business users who want to install these units into a fleet of cars.

You can use the camera's screen for instant playback at the scene of an accident so, for example, you could help police identify



the guilty party on the spot. The display's 960x240 resolution was just about good enough for us to make out the number plate of the car in front, and there's an integrated speaker for audio evidence. There's also a Mini HDMI port on the right of the camera and an HDMI cable in the box to help you play back footage on a TV from the camera.

The 402-G's menu system is reasonably easy to operate, although we're a little baffled as to why Nextbase has chosen to put the OK button – which is used to confirm selections in the menu – awkwardly out of the way on the top of the device when there are three large buttons on either side of the screen.

We're also disappointed that a camera at the premium end of the market should come without a memory card supplied. You'll need to add another £10 or so to your budget for a microSD card if you don't have one lying around. Overall, the 402-G is a very competent device with a few nagging flaws, which just keep it from an award.

RAC Digital CarCam 01



£80 inc VAT • From www.currys.co.uk

VERDICT

The CarCam 01 is a reasonably cheap, no-frills dashcam that struggles once the sun sets

THE CARCAM 01 is one of the cheapest action cams we've seen. Although nominally it costs £20 more than the Nextbase 101 Go, the CarCam 01 comes with a memory card (albeit a limited 4GB model), which means it's ready to go right out of the box.

It's not quite as compact as the 101 Go, thanks to a bulbous barrel at the bottom of the device that houses the camera lens. This rotates, making it easy to adjust the angle of the camera without fiddling with the mount.

The camera starts recording as soon as it's plugged into the charger, and there are buttons within easy reach on the back of the device to stop and start recordings manually and to switch off the internal mic. We'd prefer an option to switch off the distracting screen while driving, though. The 2in display is pretty dim, too, making it hard to see in daylight to ensure that the camera is lined up correctly.

The CarCam 01 doesn't have built-in GPS, but it includes a collision sensor that will protect any files recorded during an accident

to stop them being overwritten. There's also a File Lock button on the top of the device to protect recordings manually, if your car isn't directly involved in an accident, for example, or you simply want to make sure certain footage will be retained.

The CarCam 01 comes without software. You simply plug it into your PC with the supplied USB cable and access the recorded video files directly from its memory card. Like the 101 Go, the CarCam 01 is limited to 720p footage at 30fps, whereas most dashcams we've seen, such as the Mio MiVue 518, offer Full HD 1080p recording. Video captured in daylight showed a reasonable level of detail, but we had trouble making out the number plates of cars in adjoining lanes on the motorway, for example. The CarCam 01 also struggles with contrast, especially when part of the road is in shade and the rest is in bright sunlight, making it difficult to see what's



happening in the darker areas.

However, that's nothing compared with its problems after dark.

Footage was extremely murky in all but the brightest light, making it hard – if not impossible – to work out what's going on.

The CarCam 01 takes still images, which could be handy for recording damage for insurance accident reports, especially as they're automatically stamped with the date and time. However, there's a notable lag on the shutter button, which means you can easily introduce camera shake by moving the unit before the photo has even been taken. We weren't particularly impressed by the CarCam 01's menu system, which we found needlessly fiddly to navigate, despite there being six different buttons on the device.

When the Best Buy-winning Mio MiVue 518 costs only £10 more, we can find little reason to put up with any of the CarCam 01's numerous shortcomings

RAC Digital CarCam 02



£109 inc VAT • From www.jessops.com

VERDICT

The CarCam 02 is a great little dashcam that's seriously let down by a clumsy external GPS add-on

THE RAC'S PREMIUM dashcam is curiously cumbersome. The main unit is a perfectly compact 2.7in widescreen device that slots easily into its equally slender suction mount, and if that were all there was to it, we'd be talking about a Best Buy contender. For reasons best known to itself, though, the RAC has made the GPS facility an external add on.

The GPS unit is a 35x40x10mm block that you have to stick to the windscreen and plug into the main unit. This creates two problems. First, the reusable sticky patch that clings to the windscreen kept coming unstuck while we were driving, which was distracting and often resulted in a loss of GPS signal. Second, the receiver comes with a ridiculously long lead, which when coupled with the unit's charger cable means there's an ungainly jumble of wires sprouting from the device. You might be able to tuck these out of sight around the perimeter of your windscreen, but given that the Mio MiVue 518 and 538 have integrated GPS and are smaller than the CarCam 02, we

can't help wondering why the RAC couldn't build its own GPS receiver into the camera.

This clumsy arrangement is a shame, as otherwise the device performs well. Footage captured in Full HD at 30fps is clear both in daylight and at night. The lens's 170° field of view provides a wide sweep of the road, catching cars emerging from side roads that other cameras we've tested might miss. Detail is sharp even at high speed, and we were able to freeze the frame and read the number plates of cars coming towards us on the other side of the road. Like the CarCam 01, the CarCam 02 struggles with areas of high contrast, but it's not a major problem. Footage taken at night is grainy and suffers from the same shimmering windscreen effect we saw with the Roadhawk DC-2, although the CarCam 02 shows less distortion overall.

No software is provided with the camera. GPS co-ordinates are embedded in the video itself, and each clip is accompanied by a text file containing the GPS data for that specific



clip, although Google Maps and Google Earth refused to import the data in that format.

The camera's bright screen is perfectly visible even in bright sunlight, and is sharp enough to help you make out the details of vehicles if, for example, you need to show a police officer a recording of an incident at the roadside. The Mini HDMI port on the side of the device lets you play footage on a TV but you'll need to provide your own Mini HDMI to HDMI cable. We couldn't find an option to switch the screen off when driving, however.

The CarCam 02 takes reasonable still photos, too. There's none of the shutter lag we experienced with its cheaper sibling, although the unit is so small and light that it's easy to introduce camera shake if you don't take great care to keep the device steady.

If you're not bothered about GPS tracking, the RAC CarCam 02 may be worth a place on your shortlist. However, when the Mio MiVue 518 offers more features for £20 less, the CarCam 02 is hard to recommend.

ROADHAWK DC-2



£180 inc VAT • From shop.roadhawk.co.uk

VERDICT

The DC-2 is a distraction-free dashcam that produces superb daytime footage

THE DC-2 IS the only dashcam in this group test that doesn't have an integrated screen. Roadhawk, which mainly targets the business market, says this is a deliberate decision that ensures its devices are both legal to use (see page 101) and don't distract the driver. Having seen how the screens on other devices can divert your eye from the road, we agree this is the right approach.

We were concerned that getting the DC-2 in the right position would be tricky without a screen, but in practice it's not a problem. Roadhawk supplies two types of mount – one that sticks to the screen, and a suction-cup mount – and both are easy to adjust.

That's not to say the camera is problem-free. The LEDs that show the DC-2 has a GPS signal and is recording are dim and difficult to see in bright light. Also, the position of the power socket next to the mic input gave us some grief: it's easy to plug the power adaptor into the wrong hole, especially if you're fumbling around in the dark. The DC-2 is also

relatively chunky and was awkward to fit behind the rear-view mirror in one of our cars.

The device includes a sensor that automatically protects recordings when it detects a collision, and there's a manual override button on the back if you want to make sure a specific event isn't overwritten.

Video captured by the DC-2 was the best of any of the dedicated dashcams on test – only the GoPro surpassed it for quality. In daylight footage, distortion is minimal and detail is sharp, thanks in part to optical image stabilisation. Even in video captured on the motorway at 70mph we could easily make out number plates of passing vehicles. Night video was less impressive, with lots of noise, especially on dimly lit roads, and a sparkly effect on the windscreen that made it look as if it had been raining even in dry conditions.

GPS coordinates aren't displayed at the bottom of the video file as they are with other devices. Instead, you have to install Roadhawk's software (provided on CD and as

a download) to view location data, which you can see on a Google Map alongside the video. You can also alter the camera's settings in the software, such as resolution, brightness, contrast and spot metering.

The camera can't be connected directly to a PC – you have to remove the memory card and pop it in your computer. Roadhawk provides a USB card adaptor for those who don't have a memory card reader. It's also worth noting that Roadhawk offers an optional external GPS antenna for the DC-2 (part code 923, £20) in case a heated windscreen or special coating knocks out the signal. You can even hard-wire the unit into the car's electrical supply, and it can be connected to commercial tracking systems.

The DC-2 offers a great balance between advanced features, video quality and distraction-free driving. At £180, it's the most expensive dashcam on test, but we think the camera's quality is worth paying for. It wins a Recommended award.



SMARTPHONE DASHCAM APPS

IF YOU'VE GOT a high-end smartphone capable of recording Full HD (or even 4K) video in your pocket, you might be wondering why you should go to the trouble and expense of buying a dedicated dashcam, especially as the app stores are stuffed with free or cheap apps offering dashcam functions. However, there are several reasons why we wouldn't recommend choosing a smartphone over a dedicated device.

The first is performance: recording Full HD footage is a processor-intensive business and even high-end smartphones can struggle with continuous recording. If you've got other apps or notifications running in the background, recordings can stutter or freeze. Phones can also overheat when recording HD video for long periods, sometimes shutting themselves down to prevent damage to components. This means there's every chance you could miss an

accident, and even if the phone reboots once it's cooled down, you'll have to pull over to safely set the dashcam app running again.

Storage is another problem, particularly for owners of smartphones that don't have memory card slots. Recording HD footage consumes enormous amounts of storage, and if you've only got a gigabyte or two of spare space on, say, a 16GB iPhone, you won't be able to store more than a few minutes of footage and will face constant "low storage" warnings. Phone performance also dips when you get near the storage limits, exacerbating the problems we described above.

Mounting the smartphone on your windscreen is another potential pitfall. Many of the suction cup mounts designed for turning your smartphone into a satnav obstruct the camera lens. You'll also need a USB cigarette-lighter charger and an

extra-long USB cable that can reach the windscreen. Don't even think about running a satnav app off the battery – you'll be lucky to get more than an hour of recording before the battery is exhausted, and performance issues become more pronounced when you're running on battery power.

Using your smartphone as a dashcam also stops you using it for other things. You can't run satnav and dashcam apps simultaneously – the performance hit is too great – and even playing music in the background can be problematic. And if the phone rings while you're driving, it can interrupt recordings.

In short, we'd avoid using a smartphone as a dashcam unless you have a second phone that you can devote to that purpose. If you're still interested, though, here are a couple of dashcam apps available from the Google Play Store, which we tested on an HTC One (M8).

AUTOBOY Dashcam Pro



79p inc VAT • From play.google.com

LIKE MANY ANDROID apps, Autoboy comes in two parts. There's the free app (called Autoboy Dashcam) that contains the trial version, and you have to pay for and install the Pro part separately to convert to the full version of the app.

The interface is perfectly clear. Press the Record tile to enter the recording screen, where you'll find options to control the exposure, orientation and focus mode. Audio recording is switched off by default, which seems sensible, and there are some more frivolous options such as coloured overlays on your videos, which we're pretty sure the insurance company or police wouldn't be impressed with.

Autoboy can record video in the background, although our HTC One was pretty sluggish when doing so. If you leave the app running, you get a distracting live view of what's being recorded. You can switch to a Google Map to see your position, which may be more useful, although this feature doesn't give turn-by-turn directions.

Video quality will depend on the quality of your camera, but recordings from our HTC One were pretty jerky, largely because 14fps was the highest frame rate available. This would be good enough to get the gist of an accident, but it's nowhere near the quality of footage from our dedicated dashcams. We like the way video playback shows the live map beside the footage, though, and the way you can quickly upload clips (minus the map) to YouTube.



DAILYROADS Voyager



Free • From play.google.com

"IF YOU CAN'T record video properly with the default options, please go to the settings and experiment with various video options." That doesn't bode well when it's the first screen you see on opening DailyRoads Voyager, and sure enough we had some difficulty in our tests with this free dashcam app.

With video set to record at the maximum quality of Full HD at 30fps (its default), DailyRoads Voyager quickly crumbled. The video froze about 30 seconds in, forcing us to reboot the phone. It did the same on subsequent attempts, and the phone became hot, which suggests it was shutting down due to overheating. Once we'd allowed the phone to cool down and lowered the resolution, the performance improved, but it was still prone to the occasional crash.

The footage we recorded at top quality was decent, although without optical stabilisation, our country lane drive looked as if it had been shot in the middle of an earthquake.

As with Autoboy, you can play videos in the app with a Google Map showing your location, but Android doesn't allow speed and location data to be overlaid on videos. DailyRoads Voyager at least lets you upload this information to its servers and embed it into videos, although you have to pay for this feature. The embedded annotations are tiny, but you can just about make them out. You get 10 free credits to try this feature out for yourself.



	GOPRO	BEST BUY MIO	MIO	NEXTBASE
	Hero4 Silver	MiVue 518	MiVue 538 Deluxe	In-Car Cam 101 Go
	★★★★☆	★★★★★	★★★★☆	★★★★☆
HARDWARE				
Max video resolution	4K (Recommend 1080p for driving)	1080p	1080p	720p
Max fps (at max resolution)	15 (4K), 60 (1080p)	30	30	30
Field of view (degrees)	Ultra-wide (degrees not stated)	140	130	120
Max photo resolution	4,000x3,000	1,920x1,080	1,920x1,080	4,032x3,024
Memory card format	microSD	microSD	microSD	microSD
Supplied memory card	None	None	8GB	None
Screen size	1.8in	2.4in	2.4in	2in
Screen resolution	Not stated	480x234	480x234	320x240
GPS	No	Yes	Yes	Yes
Speed camera alerts	No	No	Yes	No
Crash sensors	No	Yes	Yes	Yes
Battery capacity	1,160mAh	240mAh	240mAh	140mAh
Stated battery life	100 mins (at 1080p, 60fps)	Up to 10 mins	Up to 10 mins	15 mins
Dimensions	41x59x30mm, 68x31x73mm in housing	65x36x65mm	67x32x62mm	68x37x58mm
Weight	84g, 157g in housing	93g	85g	56g
Connections	Mini USB, Micro HDMI	Mini USB	Mini USB, Mini HDMI	Mini USB, 2.5mm AV out
ACCESSORIES				
Supplied mounts	Adhesive mounts (suction cup +£20)	Suction cup	Suction cup	Suction cup
Also in box	Housing, USB cable, spare housing doors, pivot arm	Cigarette lighter charger	Cigarette lighter charger, soft case	Cigarette lighter charger, USB cable
Supplied software	GoPro Studio	MiVue Manager	MiVue Manager	None
Price including VAT	£279	£90	£150	£60
Supplier	www.jessops.com	www.halfords.com	www.halfords.com	audiovisualworld.co.uk
Details	gopro.com	www.mio.com	www.mio.com	www.nextbase.co.uk
Part code	CHDHY-401	MiVue 518	MiVue 538D	NBDVR101
	NEXTBASE	RAC	RAC	RECOMMENDED ROADHAWK
	In-Car Cam 402-G Professional	Digital CarCam 01	Digital CarCam 02	DC-2
	★★★★☆	★★★★☆	★★★★☆	★★★★★
HARDWARE				
Max video resolution	1080p	720p	1080p	1080p
Max fps (at max resolution)	30	30	30	30
Field of view (degrees)	140	120	170	127
Max photo resolution	4,032x3,024	2,592x1,944	2,592x1,944	N/A
Memory card format	microSD	microSD	microSD	SDXC
Supplied memory card	None	4GB	4GB	8GB
Screen size	2.7in	2in	2.7in	N/A
Screen resolution	960x240	320x240	960x240	N/A
GPS	Yes	No	Yes (external add-on, included)	Yes
Speed camera alerts	No	No	No	No
Crash sensors	Yes	Yes	Yes	Yes
Battery capacity	200mAh	300mAh	250mAh	N/A
Stated battery life	6 mins	Not stated	30 mins	N/A
Dimensions	107x38x62mm	90x19x59mm	82x37x50mm	68x26x98mm
Weight	100g	73g	60g	125g
Connections	Mini USB, Mini HDMI, 2.5mm AV out	Mini USB, 2.5mm AV out, GPS module connector (not supplied)	Mini USB, Mini HDMI	Mic in
ACCESSORIES				
Supplied mounts	Suction cup	Suction cup	Suction cup	Suction cup, adhesive mount
Also in box	Cigarette lighter charger, USB cable, HDMI cable	Cigarette lighter charger, USB cable	Cigarette lighter charger, USB cable	Cigarette lighter charger, USB card reader
Supplied software	Driving Recorder Player	None	None	Roadhawk DC-2 camera software
Price including VAT	£141	£80	£109	£180
Supplier	www.nigelohara.com	www.currys.co.uk	www.jessops.com	shop.roadhawk.co.uk
Details	www.nextbase.co.uk	www.racshop.co.uk	www.racshop.co.uk	www.roadhawk.co.uk
Part code	NBDVR402-G	Digital CarCam 01	Digital CarCam 02	rhdc2

VERDICT

The first thing this month's test proved is that an action camera or smartphone app is no real substitute for a dedicated dashboard camera.

Among the models we've tested, two in particular stand out. At the more expensive end of the price range, the Roadhawk DC-2 is our choice. Thanks to its excellent video quality, well-designed

mounts and advanced features, we think it's worth its premium price. It wins a Recommended award.

For value, however, nothing can beat the Mio MiVue 518. This dashboard camera costs less than £100 but is well designed, produces reasonable video quality and comes with excellent software. It wins a Best Buy award.

MIO
MiVue 518

★★★★★



ROADHAWK
DC-2

★★★★★



DASHCAMS AND YOUTUBE

Dashcams are always switched on and recording, which means they provide an unmatched video record of the madness on the world's roads. The number of dashcams in use (particularly in Russia and the Far East), coupled with the ease of sharing video with a global audience through YouTube, means bizarre events quickly make their way to a global audience.

These can range from the silly, such as the endless ways in which pedestrians try to commit insurance fraud, to the tragic, as fatal plane crashes are captured in harrowing detail. However, even footage of such tragic incidents can be useful to accident investigators, and some of the insurance fraud footage will show you the tricks criminals use to try to con your insurance company and lose you your no claims bonus.

A search for 'dashcam videos' on YouTube will turn up all kinds of footage and compilations. Here are some of the most interesting and frightening examples.

THE CHELYABINSK METEOR

On 15th February 2013 a meteor 20 metres in diameter and weighing more than the Eiffel Tower entered the Earth's atmosphere over the Ural mountains in Russia. Travelling at over 40,000mph, the asteroid eventually exploded around 20 miles up, causing a shock wave that blew out windows and injured 1,500 people, mostly from flying glass.

Thanks to dashcams, there was plenty of footage of this momentous event recorded from several different vehicles. You'll find a particularly good compilation at tinyurl.com/asteroiddashcam.

THE TAIPEI PLANE CRASH

Sometimes dashcams capture tragic events in horrifying detail, with the consolation that at least the footage may provide useful information for air accident investigators.

This was the case with TransAsia Airways Flight 235, an ATR-600 passenger aircraft that crashed into the Keelung river just three miles from the runway. The dashcam footage, taken from around 200 metres away, shows the plane veering sideways across a viaduct,



The tragedy of TransAsia Airways Flight 235 is still under investigation
Image credit: TVBS



↑ The Chelyabinsk meteor was brighter than the sun – before it exploded

Image credit: YouTube user Tom Tox

clipping a taxi and crashing into the river. There were 53 passengers on board and five crew, and just 15 people survived the crash. The accident is still being investigated. You can find the video at tinyurl.com/transasia235, but it is a hard one to watch.

LUDICROUS FRAUDSTERS

We'd heard of car insurance fraud, where conmen try to trick you into crashing into them to make a fraudulent claim, but we didn't realise how prevalent pedestrian fraud was. YouTube is full of videos of passers-by throwing themselves on to the bonnets of cars and rolling off on to the ground, presumably with a view to suing the driver for a made-up whiplash or back pain injury.



↑ This chap has just been involved in the gentlest road traffic accident in history

Image credit: YouTube user Tom Tox

Our favourite is the chap who calmly jogs down the middle of the road towards a car and gently Fosbury Flops on to the bonnet. The driver gets out and, although there is no sound, we presume he sternly tells the flopper to get up and be on his way. This and many other fraud attempts can be found at tinyurl.com/pedestrianfraud. Warning: in some of these videos the driver responds to the attempted fraud with his fists.

TIE FIGHTER MOTORWAY INCIDENT

They may be part of an interstellar autocratic empire, with unlimited resources and command of the greatest war machine the galaxy has ever seen, but even the Galactic Empire's finest pilots should watch out when driving in the snow.

A dashcam-equipped car captured a forlorn TIE Fighter straddling the central reservation on a wintry A3 Autobahn in Germany, one wing missing and smoke pouring from the fuselage. Two stormtroopers hang around the wreck, waiting for the Imperial Fleet to arrive with a tow.

The video is a fake, of course, created to promote Sky's *Star Wars* channel. It should act as a warning, though: some dashcam videos are faked, using software such as the excellent Hitfilm 3 Pro (see *Reviews*, *Shopper* 327). And how do we know it's a fake? Because stormtroopers don't fly TIE Fighters, obviously. TIE pilots dress in black.



TIE Fighters have shocking handling in wet and icy conditions
Image credit: YouTube user Laurent Gallen

DASHCAMS AND THE LAW

DASHCAMS WITH SCREENS that show a live view of the road seem to inhabit a legal grey area. Some of the models we've tested this month, such as the Mio dashcams, will blank their screens automatically after a few seconds, but others, such as the RAC models, leave their screen on all the time.

It's the second type of dashcam that could potentially cause legal problems. The chief issue is that there are specific regulations about the kind of screen you can have in your vehicle, and what that screen can be used for. This difficulty is compounded by the fact that the relevant regulations date from 1986 – a long way before the proliferation of devices with screens that have inveigled their way into each and every facet of our lives.

The relevant regulations are as follows:

"Regulation 109 of the Road Vehicles (Construction and Use) Regulations 1986 provides for the use of television sets or other monitors in motor vehicles.

109(1): No person shall drive, or cause or permit to be driven, a motor vehicle on a road, if the driver is in such a position as to be able to see, whether directly or by reflection, a television receiving apparatus or other cinematographic apparatus used to display anything other than information:

- (a) about the state of the vehicle or its equipment;
- (b) about the location of the vehicle and the road on which it is located;
- (c) to assist the driver to see the road adjacent to the vehicle; or
- (d) to assist the driver to reach his destination.

109(2): In this regulation television receiving apparatus means any cathode ray tube carried on a vehicle and on which there can be displayed an image derived from a television broadcast, a recording or a camera or computer."

The reference to cathode ray tubes shows how out of date these regulations are. Breaking the points down, we can see that point a) could refer to any dashboard heads-up-display, such as a trip computer, points b) and d) are fairly obvious get-outs for satnavs, and point c) covers reversing cameras.

The situation is a little trickier for cameras that show a live view of the road at all times. You could argue that showing the road ahead counts as information "about the location of the vehicle and the road on which it is located," but it's a bit of a stretch.

We haven't heard of anyone getting into trouble for using a dashcam with a live video screen, but if you'd rather not take the risk, look for a model that has a screen you can switch off, or that switches off automatically after a certain amount of time.

Insurance claims

Many of the dashcams we've tested come with built-in motion sensors, which detect the forces the camera is subjected to in an accident and automatically protect the footage that was recorded at that point to prevent it being overwritten.

This feature points to the main purpose of dashcams: to show what happened in an accident. In extreme cases this could help you avoid prosecution, but video evidence could also make insurance claims easier to sort out by acting as a definitive record of what actually happened on the road.

Dashcams could also be used to cut down on insurance fraud, where criminals cause accidents deliberately to make insurance claims. Examples of this type of fraud include drivers disabling their brake lights so you crash into the back of them, or flashing you at junctions so you pull out and then crashing into you. If you can't prove you weren't at fault, you could lose your no-claims bonus and see your insurance premiums rise, all while putting more money into the pockets of criminals.

According to insurance companies such as Aviva, this type of fraud is on the rise. It's in the interest of these companies, and that of drivers, to cut down on fraudulent claims as much as possible, as these claims put both the companies and legitimate drivers out of pocket.

For this reason, some insurers are waking up to the fact that dashcams could be good for business. Swiftcover, for example, will give you a 10% discount on your premium if you fit a dashcam. The

company seems to have a special deal with dashcam manufacturer Nextbase, too, and will offer you 12.5% off your premium if you fit a Nextbase model to your car.

Swiftcover justifies this reduction in its premiums on its website (see www.swiftcover.com/carinsurance/dashcams) by saying it believes "drivers with dashcams will be more careful on the road", but we're sure the company wouldn't mind a reduction in insurance fraud at the same time.

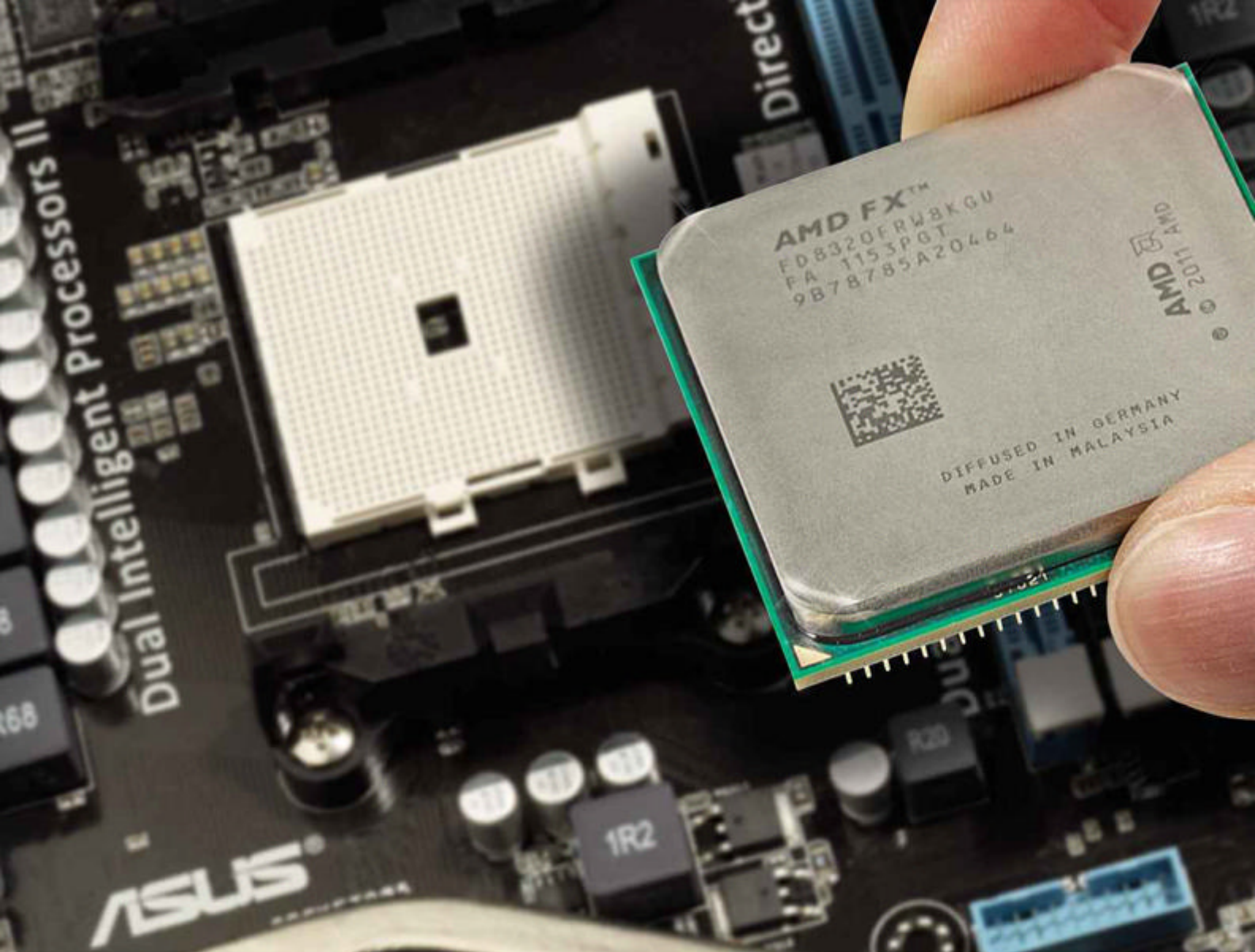
Bear in mind that using a dashcam means you'll have to be scrupulously honest in your

own claims, too. Swiftcover goes on to say that if someone is "unlucky enough to be involved in a car accident, they'd be able to send us video evidence to support their claim". However, the small print under the discount offer is more prescriptive, stating that "you must where possible send us video footage on request."

Don't forget that many dashcams use GPS to record your speed and position, too, which could get you in trouble if you were driving over the speed limit at the time of your accident. 🚗



▲ A dashcam may help you settle insurance claims and even reduce your premiums, but if insurers can find a reason in the video not to pay out, you can be pretty sure they'll use it



Build a better

Last month we showed you all the components you need for your perfect PC. Now we show you how to put them all together in a professional build

If you've never looked inside a PC, building a computer can be a daunting prospect. There are lots of bits and pieces you need to put together, and plenty of things to consider, but with a bit of research and planning it needn't be as complicated as you might imagine.

By building your own system, you'll get a greater understanding of how everything works, meaning you might not be quite so quick to pick up the phone to an expensive technical support line, or wait an age for an email response, the next time you run into any problems. Successfully putting together

your first system and booting up is also one of those satisfying moments no tech-loving person should ever miss out on.

In last month's *Shopper* (327) we tested every component you could need to build a PC, from cases to motherboards and CPUs to graphics cards. There were also plenty of options depending on your budget. Whether you want a cutting-edge gaming system, a home theatre PC or just something to do your tax return on, we've got you covered.

Even if you've built a system before, this guide will be handy to keep you up to date with the latest components and methods, as

things do change over time. You'll find handy tips and tricks that might not only save you frustration during your next build, but will also result in a cleaner and more polished system. All the better to take advantage of that large viewing window on your PC case to show off your handiwork.

What follows is a step-by-step guide that runs you through the process of putting your system together, so that by the end you'll have a fully working system you can be proud of. See opposite for a list of tools you'll need for a stress-free PC building experience, and remember: take your time and enjoy.

BEFORE YOU START

You might be tempted to dive right in and get your hands dirty, but it's worth taking a few minutes before you start to make sure you have everything you need for a smooth, trouble-free build

MULTI-HEAD SCREWDRIVER

A ratchet or electric screwdriver that supports a wide array of fitments will be more versatile than a typical crosshead screwdriver. They're useful to have around the home for other tasks beyond building a PC as well.

Choose one with a range of hex sockets that include at least 5, 6 and 7mm sizes. Magnetised tips will also help avoid losing screws down the back of the case.



nightmare to remove after you've attached them. Some electrical tape might also be useful for taping down cables to the case.

CROSSHEAD SCREWDRIVER

This will likely be your most used tool if your case doesn't have thumbscrews. A screwdriver lets you fit and adjust most of the major components as well as removing the side panel on the case itself. Pick one with a long shaft to make it easier to reach recessed screws, while a magnetised tip will stop you dropping and losing any screws along the way.



TORCH

A good source of light, be it a dedicated torch or a flashlight app on your smartphone, will help avoid frustration when building

inside your case, especially if it's all black inside. It also brings peace of mind during intricate tasks such as making sure you've lined up the processor the right way and when connecting peripherals to a PC under a desk. It's also worth choosing somewhere well-lit for you build in the first place.



ANTI-STATIC WRISTBAND

This is designed to safeguard components from static, but we don't think you really need this.

The chances of killing a PC outright with static electricity are pretty small (we've never managed it in all our collective memories). Instead you can get rid of static by grounding yourself first.

Do this by touching the bare metal of your PC case, which is grounded if plugged into the mains (leave it turned off for now though). You can also ground yourself by touching an unpainted part of a radiator. Also try to work on a non-carpeted area to avoid static build-up, and it might also be a good idea to take off that woolly jumper.

THERMAL PASTE

Thermal paste allows heat to transfer efficiently from your processor to the attached heatsink and fan. If you're buying a new full retail processor kit, the chances are you might not need this as the included cooler will likely have thermal paste pre-applied. However, it's always useful to have thermal paste lying around for the future or if you're transferring a processor from an old system.



FINE PLIERS

These will be useful for removing and fitting the tiny jumpers on the motherboard that can be fiddly to hold with

your fingers. They'll also be invaluable when you need to hold parts in tight spaces or cutting wires or cable ties.

CABLE TIES

You'll want something to bunch the various cables together inside your case, not only to look nice and neat but also to help with airflow. We'd recommend using Velcro ties as these are easy to remove if you need to make changes. Zip ties can be an absolute



A HOT BEVERAGE

Building a PC can actually be quite therapeutic and relaxing, but if things do go wrong it can be a rather frustrating experience. In

both scenarios a nice cup of tea or coffee could be just what you need. Just make sure you keep it well away from your components to avoid any unfortunate accidents.

PC

TIP

Before buying components, such as the case, graphics card or processor cooler, take the time to make sure everything is compatible. That means making sure you have an ATX case for an ATX motherboard, or that your graphics card will physically be able to fit in the case. This will help avoid frustration down the line.

Also check that you'll have enough SATA cables for your disk drives (motherboards usually come with one or two, as will retail packed SSD kits). You may also need thermal paste if you're using a third-party (not from Intel or AMD) CPU cooler.

HOW TO GET THE CASE READY

STEP 1 REMOVE THE SIDE PANEL(S)

To get inside the case you'll need to first remove the side panels. Some cases will use thumbscrews so this will be easy, otherwise grab your crosshead screwdriver to remove the screws. The priority will be the left side panel (when viewing the case front on). If you know there's space to work behind the motherboard tray in your case for cable routing, remove the right panel as well. **A**

STEP 2 TAKE OUT ACCESSORIES

Most case manufacturers will place all the accessories and instructions inside the case itself for easy transportation. Make sure you take all of these out. It's not uncommon for the screws to be in a box mounted in one of the hard drive bays, so be sure to slide this out

using the removable tray. The end result you want is an empty, clean space inside the case for you to get to work. Make sure you keep all the screws within easy reach as you'll need them later when installing the motherboard.

STEP 3 REMOVE THE FRONT PLATES

If you're planning on installing a 5¼in optical drive (or a memory card reader in the case's 3½in external bay), you'll first need to remove the port surround (or blanking) plates from the front of the case. It will probably be easiest to remove the front of the case altogether to do this, so consult the instruction manual. Most likely it will just need unclipping by pulling away from the case. Not all cases support an optical disc drive, so make sure yours does if you still need to use DVDs or CDs. **B**

STEP 4 REMOVE THE BACK PLATES

If you're planning on installing a dedicated graphics card or PCI/PCI Express card such as a TV Tuner, you'll need to also remove blanking plates that cover the expansion slots from the back of the case. These will usually have screws holding them all in place, so reach for your screwdriver if you need it. **C**

Only remove the ones you need, not only to maintain the attractive exterior but also to stop dirt entering the case. Some graphics cards require two plates to be removed. Keep hold of any screws you removed as you'll need to use these to secure your graphics card or PCI/PCI Express card once inserted. If you're having trouble working out which plates to remove, you can always take them out later when the motherboard is installed.



HOW TO INSTALL THE POWER SUPPLY

STEP 1 FIT SUPPLY ON TO SHELF

Increasingly, a lot of cases now position the power supply unit (PSU) in the bottom of the case. This can be preferable as the sheer weight of some PSUs means systems can be unbalanced when they're mounted at the top. It can also make for neater cabling as the power cables don't hang down into the case.

Which way round you install the PSU could be dictated by the case you use, so be sure to consult the manual. In some cases, you can decide to point the PSU air intake fan up or down. With the PSU fan pointed up towards the case internals, the fan can help draw warm air in and then expel it out of the rear of the case, helping to lower the temperature inside. Alternatively, you may also be able to have the



PSU fan pointed down, where the PSU will draw in cool air from outside the case, allowing it to maintain a lower operating temperature and potentially expanding its lifespan.

If your case does take a PSU in the top there will be a small shelf on which the power unit can rest. Slide the PSU on to the shelf and push it back towards the rear of the case until it makes contact. **A**

STEP 2 SCREW IN SUPPLY

With the PSU in place, make sure the screw holes match up with the back of the case. Now it's a simple matter of attaching the four screws to hold the PSU in place. Now is a good

TIP If your PSU is modular, meaning that unneeded power cables can be detached, it's easier to detach the cables now and reattach them later as this will leave you more room to work inside the case and make the PSU slightly less unwieldy to install.

TIP Power-related problems are often the cause of a system not booting. Make sure everything is properly connected and that you haven't missed a power cable before pulling your hair out.

Some PSUs let you switch the input voltage between 110V (US) and 230V (UK). Make sure yours is set correctly.

time to also attach the kettle lead and plug into a grounded wall socket so that the case is grounded. Don't turn it on yet, though. **B**

HOW TO**INSTALL THE MOTHERBOARD****STEP 1 UNPACK THE BOARD**

Open up the motherboard's box and remove its contents. Most likely you'll find the motherboard itself inside an anti-static bag. Keep hold of the bag in case you need it later, but do not place components on this bag. You'll also find a number of cables, most likely including a SATA cable or two, a driver CD and a port surround plate to insert into the rear of the case. Take these all out and put them somewhere safe for later on.

STEP 2 CHECK THE PORT SURROUND PLATE

The port surround plate (often called the backplate) fits into the back of your case and gives you access to the ports on the motherboard, typically with pre-cut holes. Occasionally motherboard manufacturers will use generic plates that fit all of their motherboards, so you might need to remove specific port covers in order to match the actual connections available.

The easiest thing to do is to hold up the plate to your motherboard's back connections to see which of them match, and then remove the ones you need. This could mean either twisting metal covers off, much like the expansion card blanking plates on the case, or it could require you to push a flap cover inwards to give access to the hole.

STEP 3 INSTALLING THE PORT SURROUND PLATE

Now that all the holes line up with the connections on your motherboard, it's time to attach the plate to the case. You'll need to install the plate from the inside of the case pushing it outwards. The ridges should face out and the writing on the plate should be readable from outside of the case. **A** That way you know you're definitely fitting it the right way. Also make sure it's the right way up, with the PS/2 keyboard and mouse connections at the top and the audio connections on the bottom. Push the plate into the opening on the case with a little bit of force and it should click into place.

STEP 4 MEASURE UP THE MOTHERBOARD

The next step is to install the motherboard inside the case. For this you will need to line up the motherboard with the pre-drilled holes in the motherboard tray. Make sure you have the right size PC case for your motherboard. For example, if you have an ATX motherboard it won't fit inside a microATX case as it's too large. A microATX board will usually happily fit inside an ATX case, however.

Take the motherboard and manoeuvre it into the case, lining it up with the port surround plate you fitted into the back of the case. Push the board in firmly so that it's flush and fitted properly. The holes on the motherboard should now line up with the holes on the motherboard tray. Take a mental note of which holes are required and remove the motherboard, placing it in (not on) the bag it came in to be safe.

STEP 5 FIT THE MOTHERBOARD STANDOFFS

Here is where the screws and accessories you put safely aside when opening up the case will come in handy. Have a dig through to find the motherboard standoffs. These are the tall, hollowed out screws that are typically made from brass. These standoffs are designed to hold the motherboard away from the case to prevent it shorting out when the motherboard contacts touch the case.

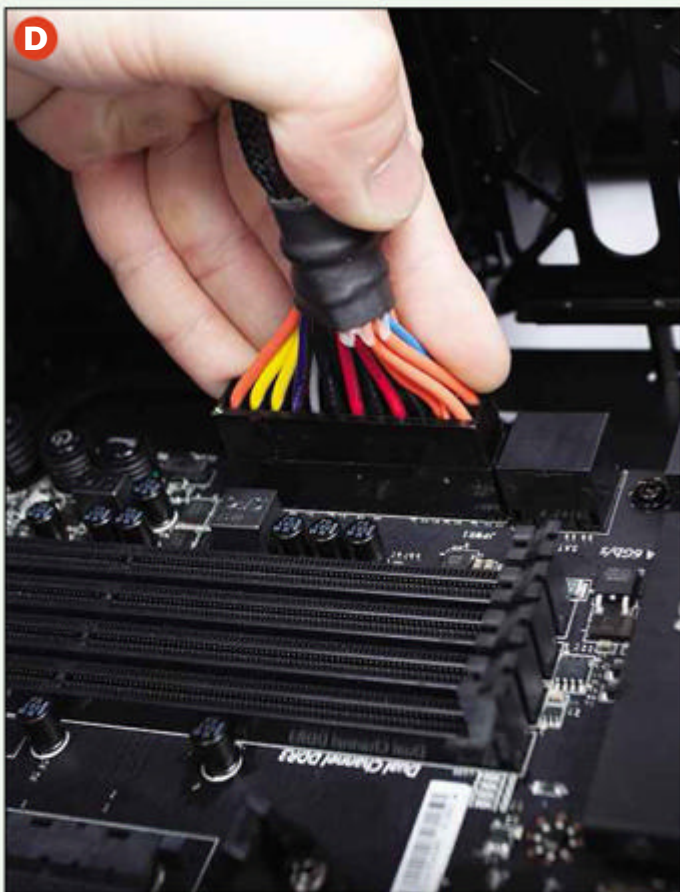
Simply screw these into the pre-drilled holes in the motherboard tray using the ones you identified in the previous step. **B** Make sure these are screwed in tight and use one for each hole on the motherboard so that it's held in securely. In some cases the standoffs might come pre-installed in the case but they might not be in the correct place for your particular motherboard. Follow the earlier instructions to make sure they're in the right place; don't leave any in the case that aren't required for your board.

STEP 6 INSTALL THE MOTHERBOARD

Once again slide the motherboard into the backplate and double-check you've installed the standoffs in the correct place. If you haven't,



remove the motherboard and fit any missing standoffs. With the standoffs in place, line the motherboard holes up and insert the screws, screwing them into the standoffs. **C** It's best to do each corner of the motherboard first so that it's held safely in place. Don't tighten them all the way yet: just tighten them enough to keep the motherboard from sliding. With the corners done, insert the screws in the remaining holes and tighten them all so that the board is secure. Don't over-tighten them as the board may crack.



STEP 7 IDENTIFY THE ATX CONNECTOR

The motherboard draws power from the PSU typically using two connectors: an ATX connector and a secondary connector. Modern motherboards use a 24-pin ATX connection, which is easily identifiable as it's the largest connection on the power supply. Older motherboards used a 20-pin connection, so your PSU might have an ATX connector with a detachable four-pin connector. Make sure that a full 24-pin connector is made by snapping the two cables together a bit like Lego.

STEP 8 ATTACH ATX CONNECTOR

The ATX connector will only plug in one way as it has a small hook and clasp for securely attaching to the motherboard. Once it's lined up correctly, attach the connection by applying a little downward force until you feel the clasp engage. **D** Give it a gentle tug afterwards to make sure it's connected properly and give it a visual inspection to make sure it's flush with the motherboard. A common reason for a PC failing to boot is that the power cables have been incorrectly attached, so here's a good chance to use that torch.

STEP 9 CONNECT THE SECONDARY CONNECTOR

Modern motherboards need a secondary power connector from the PSU. This will either be a four-pin or an eight-pin connection, depending on your motherboard. Check what type your PSU has as you might have to buy an adaptor. If your PSU is modular, make sure the correct power cable is attached. Some PSUs have an eight-pin connection that can be split in two. Much like the 24-pin connector, you'll need to line up the connector the right way round and apply a little bit of force to properly attach it. A satisfying click will let you know when it's in. **E**

Modern motherboards use a 24-pin ATX connection, which is easily identifiable as it's the largest connection on the PSU

THIRD-PARTY INTEL COOLERS

If you're using a motherboard for Intel processors and are planning on using a third-party cooler, make sure you install the motherboard backplate before you fit the motherboard into the case (see 'How to install an Intel processor', page 109, Step 4). Otherwise it will be a nightmare having to remove the motherboard unless your case provides rear access.



HOW TO INSTALL THE CASE FANS

STEP 1 IDENTIFY MOUNTING POINTS

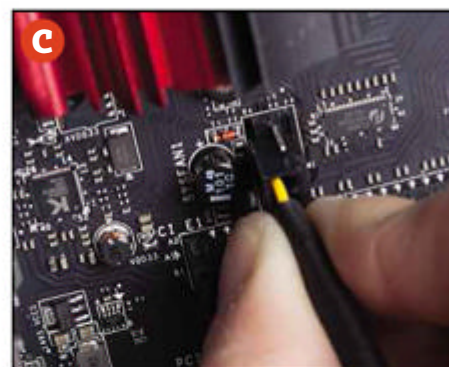
Most cases come with at least one fan pre-installed, and they normally have two (excluding the fan built into your power supply). Typically one is installed in the front as an intake and another at the back as an exhaust. That way cool air is drawn into the system and across your components, with the warm air expelled out of the back.

If you only have one fan, or are building a very powerful PC, then a second, third and even fourth fan might be a good idea. First you need to identify what size fans your case will support. Standard sizes are 80mm, 120mm, 140mm and occasionally 200mm, but consult the case's manual or specifications.

Some mounting points are able to support two different sizes, such as 120mm or 140mm fans. Given the choice, it's a good idea to go for the largest fan available. These will be able to move air far more efficiently and with less noise generated as they can operate at lower speeds. **A**

STEP 2 ORIENTATE THE FAN

Fans only blow air in one direction, which means it's important you pay attention to which way you mount the fan to the case. **B** You don't want a fan that is supposed to act as an exhaust blowing air back into the case. Pay attention to any labelling on the fan itself. There might be an arrow on the top of the fan's enclosure that indicates the direction of air, otherwise air will normally flow out of the side of the fan with the stickered labelling. Consult the instructions if in doubt.



STEP 3 SCREW IN THE FAN

The fan should come with screws, or some may have been included with the case. Go through the accessories box you put aside earlier. The fan simply requires the installation of four screws to hold it in place. Tighten the screws so the fan is secure, but not so tight that you might damage the fan's enclosure. It's also a

good idea to remove the fans occasionally for cleaning, so you don't want to come back and find it won't budge. **C**

STEP 4 CONNECT FANS TO BOARD

The fans will need to be connected to the motherboard for power (see 'How to connect the case and fan cables', page 111).

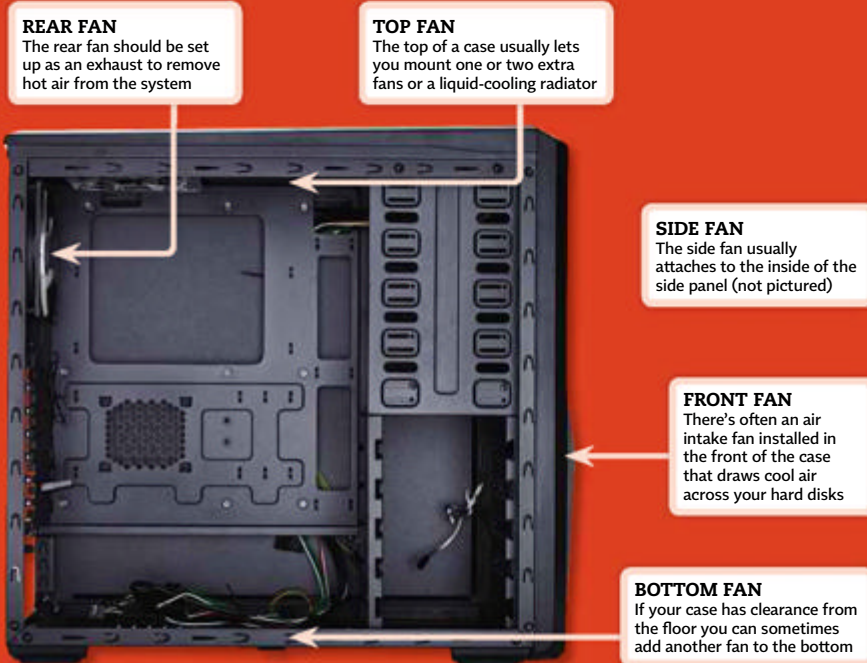
FAN LAYOUT

How you decide to place the fans around the case will be dependent on your case's shape and design, but there are some general guidelines you should follow. The normal mounting points for fans are the rear, front, side and top.

Some cases also have a mounting point on the bottom if they have feet to provide the necessary clearance from the floor. If your system is going to be placed on the floor, it's not advisable to install a fan in the bottom as this will draw in dust and dirt even with a dust filter installed.

You want to set up your fans so that they create a wind tunnel inside the case. It might also be a good idea to have more exhaust fans than intakes; that way a vacuum is created inside the case that draws in air beyond just the air intake fans. That means cool air will be drawn in from any other openings in the case.

A good starting point would be to have a front fan air intake, a side air intake, a rear exhaust and a top exhaust. All your components should then have cool air drawn across them and heat will be removed from the case.



HOW TO INSTALL AN AMD PROCESSOR

STEP 1 OPEN THE SOCKET LEVER

AMD's AM3, FM2 and FM2+ processors fit directly into a socket on the motherboard. The first step is to lift the metal lever to release the socket. The entire fixture will move slightly backwards and align the holes in the plastic socket with the connectors beneath. **A**

STEP 2 FIT THE PROCESSOR

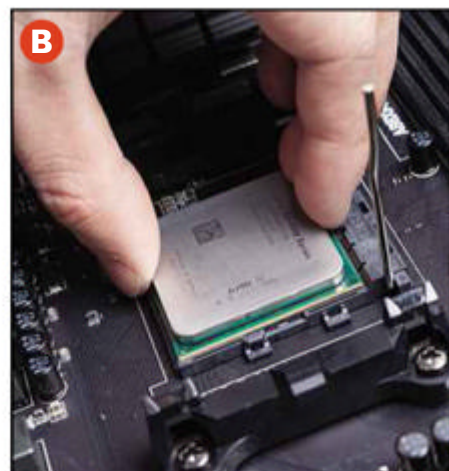
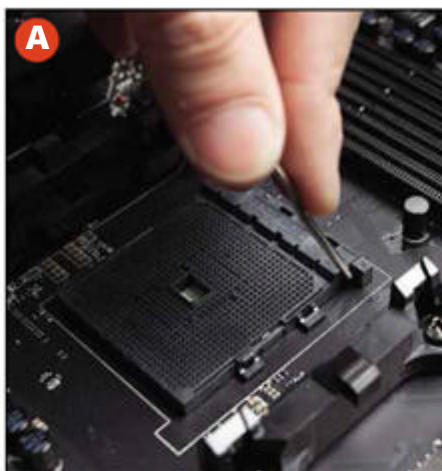
The processor is a delicate component, so hold it from the edges and avoid touching the pins underneath. The processor will fit only one way into the socket so will require no force.

There's a small arrow on the corner of the processor and a matching arrow on the corner of the socket. Line these two up and the processor will simply drop into place with zero fuss. If it feels as if the processor is not sitting flush with the motherboard, do not re-close the lever as this could damage the connections on the processor. Instead, double-check that the arrows are lined up and that the processor is squarely in the socket. Once you're sure everything is set, close the lever again to lock the processor securely in place. **B**

STEP 3 APPLY THERMAL PASTE

You can skip this step if you've bought a new retail processor kit as the cooler will already have thermal paste pre-applied. If there's what looks like a silver sticker on the bottom of the heatsink, this is actually a layer of thermal paste. Thermal paste helps to conduct heat away from the processor into the heatsink of the cooler, keeping temperatures under control.

If there isn't any pre-applied paste, you'll need to add your own. A small amount goes a long way so apply just a little on the top of the processor to start (no more than half a pea-sized lump). Use a thin bit of card to spread the thermal paste evenly across the top of the processor, avoiding getting any over the sides. Add more if necessary. **C**



STEP 4 FIT THE COOLER

The cooler supplied by AMD with its processor retail kits is relatively straightforward to fit, although it does take a little bit of force. There's a large metal rod that extends beyond the sides of the cooler. This is designed to latch on to plastic tabs surrounding the processor socket on the motherboard.

First orientate the cooler so that the CPU cooler connection is closest to the cable for easy reach (see 'How to connect the case and fan cables', page 111). Then, take the cooler and

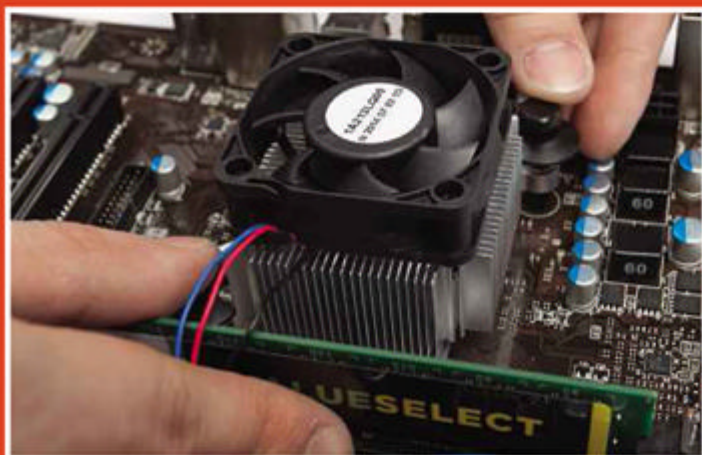
open the lever so that the metal clips move freely. Place the cooler over the top of the processor and take the clip on the opposite side of the lever and attach it over the plastic tab so that it hooks up. Now take the other latch and, with a bit of effort, press down so that this also hooks on to the tab.

With both sides connected, close the lever to lock the processor cooler into place. This may also take a little bit of force. The cooler should be tightly locked to the motherboard, and you shouldn't feel any wiggle. **D**

FITTING AN AM1 COOLER

If you're installing one of AMD's budget AM1 processors, the cooler-mounting process is different to the other socket types. AM1 uses push-pins that punch through pre-set holes on the motherboard rather than the locking clasps used for AMD's other processor sockets. These can be a bit tricky to install if you follow the instructions included with the cooler, so use this guide instead.

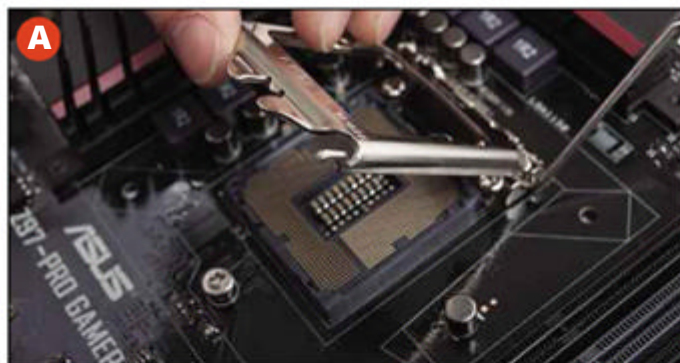
To install the cooler, first line it up so that the two push-pins are above the holes in the motherboard. Push down on one of them until it goes through the motherboard, and insert the holding pin through the hole to keep it in place. Now do the same for the other corner of the cooler. This side will have risen up slightly so will be a bit trickier than the first. With both pins in place, the cooler will be securely locked to the processor.



HOW TO INSTALL AN INTEL PROCESSOR

STEP 1 LIFT THE PROCESSOR CAGE

First you'll need to remove the plastic cover on the processor socket to expose the cutout in the metal housing. This should simply pop out. To access the socket, you'll need to unclip the handle that runs down the side of the socket. Lift this up to release the retaining clip on the main cage. Now lift the main cage up and out of the way to expose the socket. The pins for an Intel motherboard are on the board itself, so be sure not to damage these as bending them will stop the motherboard communicating with or powering the processor properly. **A**



STEP 2 INSTALL THE PROCESSOR

Now line up the two cutout notches on the sides of the processor with the ridges in the socket. An arrow on the processor should line up with the corner of the socket that has a missing pin. The processor should drop gently into place and sit flush with the socket. If it doesn't, and there's some lateral movement, the processor is in the wrong way. Carefully lift it up and align again.

Close the metal cage and pull the retaining handle down. This might require a little bit of force, so again double-check the processor is positioned correctly before pressing down too hard. Slide the handle back into its locking position to securely put the processor in place. **B**



STEP 3 APPLY THERMAL PASTE

Chances are that if you bought a new processor with an included cooler, there's already thermal paste pre-applied. If not, see 'How to install an AMD processor', step 3 (opposite) for how to apply your own.

STEP 4 FIT THE COOLER

If you're using a third-party cooler be sure to check the instructions as they might differ from standard Intel reference coolers that come with Intel's processor kits. Some might require you to install a motherboard backplate to hold the cooler in place, especially the larger coolers.

The standard Intel reference cooler uses four feet that are secured into the holes surrounding the processor socket on the motherboard. Make sure these are rotated away from the direction of the arrow to start. It's sensible to orientate the cooler so that the fan's power cable is close to the CPU fan header on the motherboard.

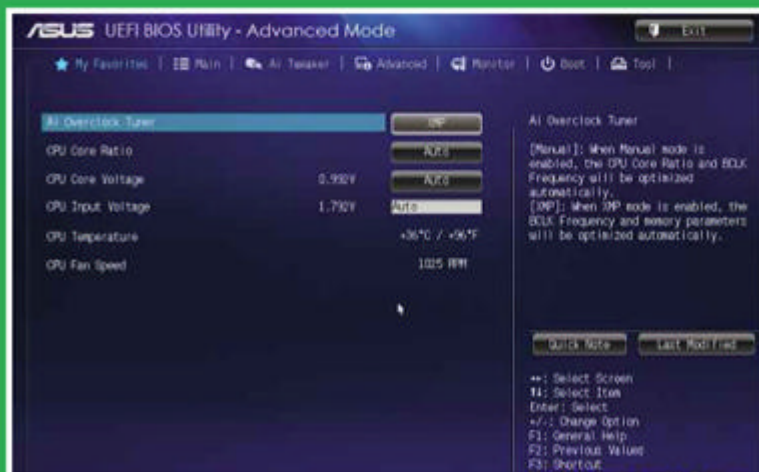
Line up the four feet with the holes and start by pressing down on two diagonally opposite feet so that they lock into the motherboard. These should click into position so you know they're secure. Now do the other two corners and the cooler should be securely in place. If you need to release the feet, simply use a screwdriver to turn the top of each foot as indicated by the arrow to release it. **C**



MOTHERBOARD COMPATIBILITY

If your motherboard is particularly old or your processor is particularly new, you might run into compatibility issues. Although all the motherboards we tested last month should work out of the box with our recommended processors, some motherboards will only work with the latest processors following a BIOS upgrade. A problem occurs when certain motherboards won't boot to the BIOS without a compatible processor installed, meaning you're incapable of updating the BIOS with the chip you have.

In this scenario you will need an older compatible processor to let you get to the BIOS flashing interface and then swap the processors once upgraded the BIOS. Alternatively, some motherboards also allow you to flash a BIOS using a dedicated button on the motherboard that will allow it to take a BIOS update from a connected USB flash drive. Be sure to check your processor is compatible with your motherboard or that you will be in a position to upgrade the BIOS if needed.



HOW TO INSTALL MEMORY

STEP 1 IDENTIFY THE SLOTS TO USE

If you want to take advantage of the performance increase of dual-channel architecture (there's no reason you wouldn't), the first step will be identifying which memory slots you should use as a matching pair. Frustratingly, motherboard manufacturers seem incapable of settling on a standard, so you might have to consult the manual if your motherboard has more than two slots.

Most memory slots are colour-coded, but whether you should install two modules in identically coloured slots or in different coloured slots will be down the manufacturer. The slots might also be numbered, so inspect the markings on the motherboard. These will make following the instructions easier.

STEP 2 OPEN THE RETAINING CLIPS

Clips on each end of the slot hold the memory in place. You'll need to open up the clips on each end by pressing down on them. They should pop open up to around 45° without much effort so that you're ready to insert the memory module. **A**

STEP 3 LINE UP AND INSERT MEMORY

There's an off-centre ridge on the memory slot on the motherboard and a slit on the memory module. Match these up to make sure you're inserting the memory module



the right way round. Provided you have the right memory for your motherboard, everything should line up.

STEP 4 CLIP THE MEMORY IN PLACE

Once everything is lined up, press the memory into the slot by applying even pressure on

each end. **B** The clips should spring back and lock into place with a click. Check the clips are nestled securely against the side of the memory module; if not, you might have to press down a little bit harder until there's better contact. Repeat these steps for any other memory modules you need to install.

HOW MUCH RAM CAN I INSTALL?

Different motherboards have different numbers of memory slots, but also support different maximum amounts of memory. Typically a non-specialist motherboard with two memory slots will support a maximum of 16GB and a motherboard with four slots will support 32GB of memory. Unless you're performing any particularly demanding

tasks, such as video editing, 8GB is usually enough for day-to-day use.

You should also note which version of Windows you want to install (if this is your chosen operating system; see page 116 for help on installing other operating systems). Different versions have different memory limitations, as shown in the table below.

VERSION	32-BIT LIMIT	64-BIT LIMIT
Windows 8		
Windows 8	4GB	128GB
Windows 8 Professional	4GB	512GB
Windows 8 Enterprise	4GB	512GB
Windows 7		
Windows 7 Starter	2GB	N/A
Windows 7 Home Basic	4GB	8GB
Windows 7 Home Premium	4GB	16GB
Windows 7 Professional/Enterprise/Ultimate	4GB	192GB

DUAL-CHANNEL MEMORY

Dual-channel architecture is a motherboard technology that essentially doubles the amount of available memory bandwidth, helping to remove any potential performance bottleneck when the memory is unable to match the processor's performance. By installing a pair of memory modules in two matching banks, each module is able to access the memory controller separately to increase throughput bandwidth.

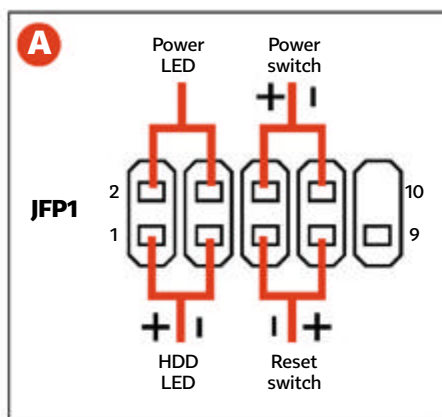
It's generally a good idea to match the two memory modules for best compatibility, and many modules are sold as paired kits. If one module is rated at a slower speed than the other (for example, if one is 1,600MHz and the other is 1,333MHz), both will run at the slower speed in dual-channel mode.

If you're installing four modules they don't all need to be identical, but make sure pairs match up accordingly and are installed in their respective slots.

HOW TO**CONNECT THE CASE AND FAN CABLES****STEP 1 CONNECT CASE CABLES TO THE MOTHERBOARD**

There will be a number of different loose cables coming from your case that will need to be connected to headers on the motherboard. Connections for the power button, reset button and status LEDs are all grouped together. The cluster of headers you need might be labelled 'Panel' or 'JFP1'. Consult your motherboard manual to be sure. Get the cables ready to be attached. They might have been tucked away behind the motherboard.

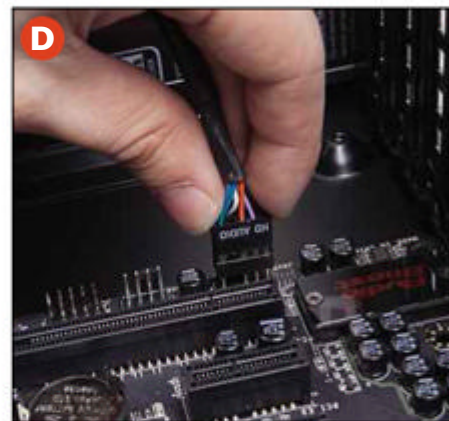
You can see an example of what you should be looking for on the right **A**. If you have trouble connecting the fiddly headers by hand, use a pair of pliers to help you.

**STEP 2 CONNECT THE POWER CABLE**

One of the cables is the two-pin power cable, which will allow your case's power switch to turn the system on. The cable will connect to a pair of pins that is among the cluster of other headers described above. If you're lucky, the motherboard might have a 'Power SW' marking inscribed next to the relevant header. If not, you'll need to consult a diagram in the motherboard's manual in order to identify the correct headers. The power cable will slide over the two pins.

**STEP 3 CONNECT THE RESET CABLE**

If your case has a reset button, this will also need to be connected to the same group of headers. Again, you're looking for the header for 'RESET SW'; look on the motherboard or in the instruction manual. Slide the cable over the two pins as above.

**STEP 4 CONNECT THE POWER AND HDD LEDs**

These are the status indicator LEDs that flash on the front of your case to tell you it's turned on or the HDD is active. These cables have plus and minus polarity, so it's important they're fitted to the correct header. The end of the cable will be marked for polarity. Consult the manual to make sure you connect the cable to the right header on the motherboard.

STEP 5 CONNECT USB HEADERS

If your case has front-mounted USB ports or a memory card reader, these will need to be connected to headers on the motherboard. The cable from the case will be labelled 'USB' and will be larger than the ones you've connected in the previous steps.

Look for headers marked 'USB' on your motherboard. This may be followed by a number, and there may be more than one header available, depending on your motherboard. It's advisable to use whichever is closest to the cable's origin to avoid messy cabling. The header on the motherboard is arranged by one row of five headers and another row of four, so one is missing from the corner. Make sure you look at the

connector end of the case's USB cable and line this up with the header on the motherboard. It should fit only one way. **B**

STEP 6 CONNECT USB3 HEADERS

Your case may also have a USB3 port on the front, which is the much faster USB standard. This lets you connect faster USB3 devices such as flash drives, which will be able to transfer files much faster than plain old USB.

The USB3 header will look different to a regular USB header and there may only be one of them. If your motherboard is an older model, it may not have any at all, so check the specifications and manual. The cable will only attach in one way, so make sure you have it the right way round. **C**

STEP 7 CONNECT THE AUDIO PORTS

The headphone and microphone jacks on the front of your case also need to be connected. The cable will be labelled 'HD Audio' on its connector. This might be labelled on your motherboard as 'JAUD1' or 'AAFP'; consult the instruction manual if you're unsure. This cable will again attach in only one way, so make sure you have it the right way round.

If your case has a built-in speaker for warning beeps, this will also need to be connected. The speaker headers on the motherboard may be in the same cluster of headers as the power and reset headers you connected earlier or nearby. The correct header will be labelled 'Speaker'. **D**

STEP 8 CONNECT THE FANS TO THE MOTHERBOARD

Fans can be connected directly to the PSU, but it's best to connect them to the motherboard instead. This way they can still get the power they need to operate but can also communicate directly with the motherboard. The motherboard will be able to control fan speed, which is useful if you want to strike a balance between case temperature and the noise generated by the fans.

Your fans will end in three- or four-pin connectors. Have a look on the motherboard for jumpers labelled 'SYS_FAN', 'PWR_FAN' or 'CHA_FAN'. There will probably be more than one at different positions on the motherboard, so use whichever is closest to the corresponding fan.

STEP 9 CONNECT THE CPU FAN

The fan on the processor cooler we installed earlier will also need to be connected to the motherboard. Failure to do so might result in your motherboard giving you an error or the processor quickly overheating and automatically shutting down the system. Much like the case fans, the processor's fan speed is controlled by the motherboard.

Connect the CPU fan to a connector labelled 'CPU_FAN' on the motherboard, typically located right next to the processor socket. Like the other connections, it will only plug in one way. This will either be a four-pin or three-pin connector.

HOW TO INSTALL A STORAGE DISK

STEP 1 FIT STORAGE DISK INTO A BAY

Solid-state disks (SSDs) are a popular choice for storage these days, and most new cases have dedicated 2½in drive bays to accommodate them. In older cases you might have to install your SSDs in a 3½in bay using mounting brackets. Many SSD retail kits include these, or you can buy them online separately. As a stopgap you can pretty much put your SSD anywhere in the case, as it doesn't vibrate or create much heat.

Some cases mount 2½in SSDs around the case. Consult the instruction manual to see if there are SSD vertical mounting points behind the motherboard tray, in the bottom of the case, or elsewhere. You'll need to secure the SSD to these mounting points using the screws supplied with the case. **A**

Whether you're installing a 2½in or a 3½in drive, it helps if your case supports tool-less installation using drive cages or rails. If yours does, slide the storage disk in; the rails on the side should hold it in place. Some cases require you to screw in rails to the storage disk and then slide the entire assembly into the drive cage.

If you're installing a 3½in drive, first locate a vacant 3½in drive bay on your case. This will most likely be in the front of the case but some cases might position them elsewhere, such as at the bottom of the case, depending on their shape and design. Don't use an external bay (one that has a cutout in the front of the case) as these are designed to be used with memory card readers.

STEP 2 PLUG IN SATA POWER

The SATA power connector is the wider of the two thin connectors on the disk drive, and needs to be connected to your PSU to provide power to the drive. Locate the SATA power cable coming from your PSU (or attach it if your PSU is modular). Connect this to the SATA power connector on the hard disk itself. Look closely and you'll see it's an elongated 'L' shape, so it will only connect one way.

Make sure you connect it straight in, avoiding any downward pressure, as this could damage the connector. **B**

STEP 3 CONNECT THE SATA DATA CABLE TO THE STORAGE DISK

The other thin connection on your SSD or hard disk is the SATA data connection. This is what carries the data between the storage disk and the motherboard. Your motherboard will come with SATA cables included, so locate the accessories you put aside earlier.



Your hard disk may have also come with SATA cables if it was a retail kit.

The SATA cable may terminate in a straight connection, or it may be an angled L-shaped connection. The latter is better for neater cabling as the cable isn't angled straight out of the connector. Like the power connection, the cable will only connect in one way. Push it straight in and you should feel a subtle click to let you know it's securely connected. **C**

STEP 4 CONNECT THE SATA CABLE TO THE MOTHERBOARD

Now you need to connect the other end of the SATA cable to the motherboard. First locate the SATA connections on your motherboard. These are usually at the bottom right of the board. Some of the connections may be facing sideways and placed along the edge.

Each SATA port should be numbered, which will let you know the motherboard's default boot order (unless you change the boot priority in the BIOS). Lower-numbered SATA ports will boot first. Therefore if you're installing more than one disk drive, make sure that the disk drive you're using as a boot disk (the one on which your operating system will be installed) is plugged into the lowest-numbered port.

You may need to make sure all the SATA ports behave in the same way, as some may be reserved for special uses such as RAID arrays, and some may be the slower SATA2 standard. You'll want to connect an SSD to a SATA3 port as they benefit from faster transfer speeds. The SATA cable will only connect one way to the motherboard and will click securely into place. **D**

M.2 AND MSATA

M.2 and mSATA SSDs are both relatively new technologies, and they're a great choice as a fast system disk for your operating system. These connect directly to a dedicated socket on the motherboard, usually near the middle of the board. They're not just great for speed, but also for neatness as no additional power or data-transfer cables are needed.

To install an mSATA SSD, match the ridges and notches on the mSATA SSD and the socket. Insert the drive at around a 45° angle until it's flush with the socket. Then lay the mSATA SSD flat. The disk will either be held in place with retaining clips, similar to the memory modules, or you may need to install screws. Use the screws included with the mSATA SSD.

The process for an M.2 SSD is very similar. You may need to remove an existing pre-installed retaining screw from the motherboard before you install the M.2 SSD. Once the SSD is installed you can re-install the retaining screw at the end to hold it in place.



TIP

Depending on your power supply unit, you may need to use a SATA-to-four-pin Molex adaptor if one isn't already connected.

HOW TO INSTALL AN OPTICAL DRIVE

STEP 1 FIT THE DRIVE

Many new PCs and laptops no longer come with optical disc drives. If you want an optical drive for reading DVD-ROM or DVD and Blu-ray movies, you'll need to make sure your case supports external 5¼in drives.

The standard way to install an optical drive is to insert it from the front of the case, rather than the inside as with your hard disks. **A** The first thing you'll need to do is to remove the case's front panel. Chances are this will just pop off, but consult your manual if this isn't the case. Slide the optical disc drive into the drive bay and push it back until the front is flush with the case. Screw-holes on the side of the drive should line up with holes in the drive bay. Secure the optical drive in place using four screws, much as you would with your hard disk. You should use four screws in total, two on each side. **B**

STEP 2 PLUG IN SATA POWER CABLE

Just as you did with your storage disks, you'll need to connect your optical drive to the PSU using a SATA power cable. Attach the cable



and make sure it's inserted all the way (see the image in 'How to install a storage disk', opposite, to know what to look for). Older optical drives may use a Molex cable, one of which should be available on your PSU.

STEP 3 CONNECT THE SATA CABLE TO THE OPTICAL DRIVE

Now connect a SATA cable to the back of the optical drive as you did with your storage disks. If you've installed a few storage disks you might be running low on SATA cables unless your optical disk drive had one



included, so make sure you have enough. You can pick up a SATA cable for as little as £1 from www.ebuyer.com.

STEP 4 CONNECT THE SATA CABLE TO THE MOTHERBOARD

Locate the SATA ports on your motherboard that you used earlier for your storage disks. If your motherboard has a mix of SATA2 and SATA3 ports, use a SATA2 port for your optical drive as they don't benefit from faster speeds. You can then save your SATA3 ports for future additions.

HOW TO INSTALL A GRAPHICS CARD

STEP 1 REMOVE THE BLANKING PLATE

We showed you how to remove the rear blanking plates on your case in 'How to get the case ready' on page 104. It's a little easier to do this when the case is empty, but if you've already fitted your other components, it's not too late; follow the instructions on page 104.

If your graphics card is double-height, you'll need to remove two blanking plates.

STEP 2 IDENTIFY THE PCI-E x16 SLOT

Graphics cards connect to a PCI Express x16 (PCI-E x16) slot on your motherboard. This is usually the longest slot on the motherboard next to the blanking plates. Your motherboard may have more than one PCI-E x16 slot, allowing you to install more than one graphics card for increased performance. If you're only installing one graphics card you'll want to use the slot nearest the top of the motherboard, towards the processor. This is because this slot will run at full x16 speed whereas other slots may run only at x8 or x4 speeds.

STEP 3 FIT THE GRAPHICS CARD

To fit the graphics card you'll need to line up the card with the slot in the drive, with the output connections towards the vacant blanking plates you removed earlier. The graphics card's fans will normally be pointing towards the bottom of the case.

Push the graphics card down and towards the back of the case so that the display output



connections are available from the back of the case. Exert even pressure down on the graphics card into the slot. **A** A retaining clip towards the end of the slot will click into place when the graphics card has been successfully connected. The whole of the graphics card's connector should sit level within the motherboard slot.

STEP 4 SCREW THE CARD INTO PLACE

You'll need to now insert the screw(s) you saved earlier when removing the backplate(s). This will secure the graphics card to the rear slot and stop it from moving around or coming loose.

STEP 5 PLUG IN THE POWER

Most graphics cards require separate power from the PSU using either a six-pin or an



eight-pin power connector. Some of the more power-hungry models might even need two connectors. Any modern power supply will have these connectors; otherwise a Molex-to-PCI Express adaptor is often bundled with the card. **B**

HOW TO INSTALL EXPANSION CARDS

STEP 1 IDENTIFY A SPARE SLOT

Depending on what you're planning to install, you may need to install software before you fit your new card. This means it should be the last thing you do, after everything else has been set up and you've installed an operating system.

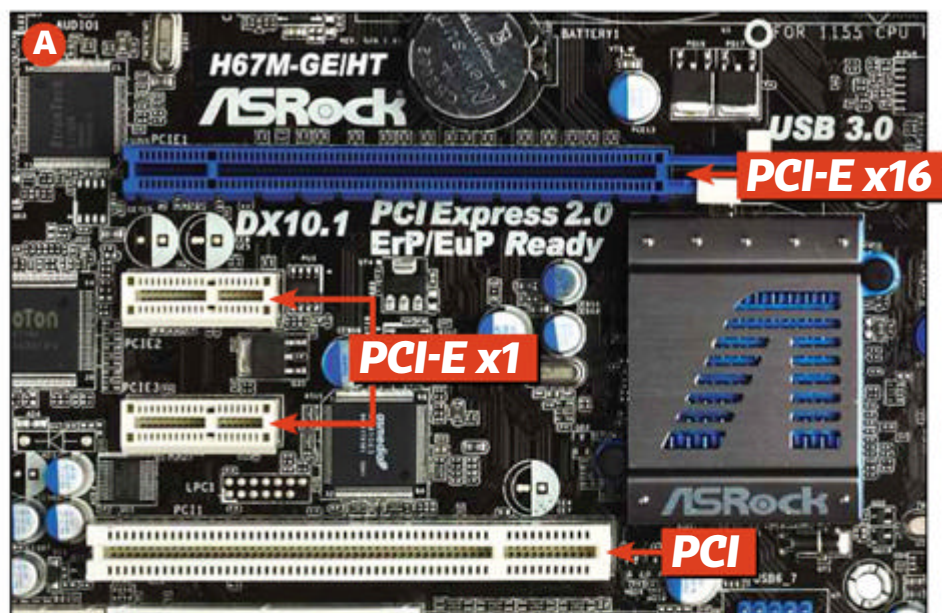
When you're ready, locate a PCI Express (PCI-E x1) or PCI slot, depending on the card you're installing. Not all motherboards have both, so check what's available on your board before you buy an expansion card. Look at the image on the right to identify which slots you have **A**. It's best to try and leave some space between components to help with airflow, so use the slot furthest away from the graphics card if you have one installed.

STEP 2 REMOVE THE BLANKING PLATE

You might have already removed the blanking plate while initially setting up the case. If not, now is the time. It will either be individually screwed in or held in place by a retaining bar. Sometimes the blanking plate will lift straight out, but you might need to rock the blanking plate out and break it off the case. Be careful with any sharp edges and be sure to keep hold of the screw for later.

STEP 3 INSTALL THE CARD

The procedure for installing a PCI or a PCI Express card is the same. Line up the notches and ridges between the card and the slot; they will only fit one way. Apply some downward force to get the card to sit securely in the slot. Unlike the PCI-E x16 slot used for the graphics card, there's no retaining clip at the end, so don't worry about not feeling a click when the card is seated. Just make sure



the entire card connector is level within the motherboard slot down its entire length. **B**

STEP 4 SCREW THE CARD INTO PLACE

With the card fitted, secure it in its slot using the screw you retained. This will stop the card moving when you connect anything through the rear of the case, such as external antennas.

STEP 5 PLUG IN THE POWER

Most PCI and PCI Express expansion cards don't need separate power, instead drawing what they need from the motherboard. If your card does require power, connect it to the PSU using whichever cable it requires.



HOW TO ROUTE YOUR CABLES

STEP 1 TIE-OFF EXCESS CABLES

Some cables, such as the front panel audio, branch into two connections when you only need to use one of them. This usually means that a second connection branches off just before the main cable terminates. Fold the excess cable back on itself and tie it down to the main cable so it's out of the way. Do this for any other cables around the case, such as the PSU's SATA power cables.

STEP 2 BUNDLE TOGETHER CABLES

Any cables close to one another should be bundled together to make one thick cable. Use several ties along their length. You can also group together several smaller bundles where possible. It's not advisable to use zip ties as these are a nightmare to remove.

If your case lets you route cables behind the motherboard, see the next step. If not, try



to route as many cables as possible along the edge of the case so they're out of the way. You can use electrical tape for this. You can also tie cables to the drive bays. Keep the cables clear of any fans as they can cause an obstruction.

STEP 3 ROUTE CABLES BEHIND BOARD

Not all cases let you route cables behind the motherboard, but if yours does it's definitely something you want to take advantage of. This

takes them out of the airflow path across the components, allowing the fans to work more efficiently. If you have a window on the side panel, it also makes your PC more attractive.

Your case may have several rubber-covered passthrough holes through which you can route the cabling. Route any excess cable through one of these holes towards the back of the tray and then back round again to the front through another hole, a bit like sewing a stitch, so that the cables can be connected to components or the motherboard. There will be several passthrough holes, so use whichever is closest to the cables' intended destination to reduce the amount of cable on show.

Be sure to run the cables in such a way that they sit flat against the back of the motherboard tray. This is to ensure the side panel isn't blocked by bulging cables and that you're able to put it back on properly. **A**

HOW TO**PUT THE CASE BACK TOGETHER****STEP 1 FINAL CHECKS**

Now that everything is attached, now is a good time to do a final check. Make sure all the motherboard connections are securely in place. One of the most common reasons for a boot failure is a loose cable, so it pays to double- or even triple-check. Similarly, make sure all the components, such as the RAM and graphics card, are seated correctly.

Make sure there's no loose cabling that could obstruct the fans. Go back to 'How to route your cables' (opposite) if necessary.

STEP 2 ATTACH THE FRONT OF THE CASE

With the final checks completed, you're ready to re-assemble the case. If you removed the front of the case to install an optical drive or attach a fan, now is the time to re-attach it. It



should just clip back into place, but consult the manual if your case is different. **A**



place so that the clips line up with the grooves. Re-insert the screws to hold the panels in place either using thumbscrews or a screwdriver. If you cabled correctly, you shouldn't have any problems with the side panel behind the motherboard tray. **B**

STEP 3 ATTACH THE SIDE PANELS

Next up are the side panels. To re-attach them on most cases you simply slide them into

HOW TO**CONNECT PERIPHERALS****STEP 1 CONNECT THE KEYBOARD AND MOUSE**

You'll need to connect a keyboard and mouse before you get started. Older keyboards and mice use PS/2 connections, which your motherboard should have. Most new keyboards and mice use USB, or a USB dongle if they're wireless. Connect either of these to the rear USB ports.

STEP 3 CONNECT SPEAKERS

If you have a set of speakers you want to connect, now is the time. If you're simply connecting a pair of stereo speakers, connect the 3.5mm audio cable from the speakers into the green audio jack on the motherboard or into your dedicated sound card.

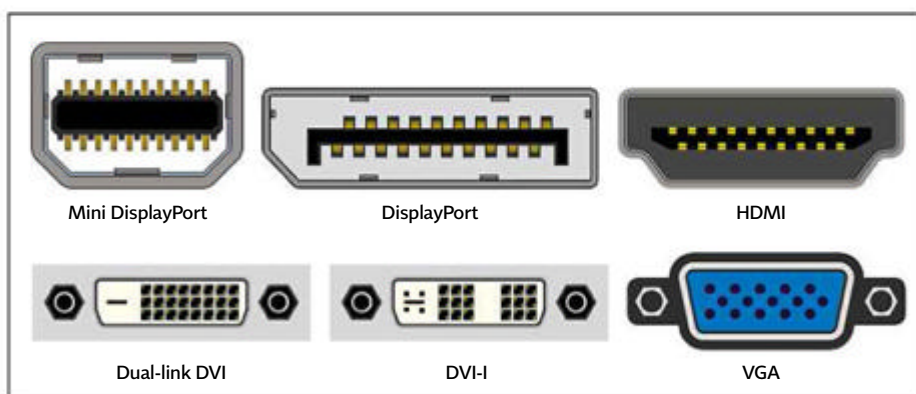
Surround-sound speakers require a few more connections. Simply match the colour-coded cables with the matching coloured ports for the satellite speakers and subwoofer.

STEP 3 CONNECT A NETWORK CABLE

If you're planning on using an Ethernet cable for networking, connect it to the Ethernet port on the motherboard. The other end of the cable can be connected to your router, HomePlug adaptor or Wi-Fi bridge. **A**

STEP 4 PLUG IN THE MONITOR

Modern PCs have numerous options for connecting a display. Most motherboards have onboard graphics, which are fine for most tasks. However, if you've invested in a graphics card to play games then you'll want to use the outputs it provides. You'll have a selection of outputs, including VGA (also known as D-sub), DVI and HDMI, plus possibly DisplayPort. The last three are digital connections, while VGA is an older analogue connection.



Most modern monitors support DVI and HDMI inputs, some also have DisplayPort, and some older monitors may only support VGA. DVI and HDMI are largely interchangeable, and you can buy a DVI-to-HDMI cable. You can also output audio over HDMI, so if you want to use monitor speakers or are connecting your PC to a TV it's the best choice.

Monitors with high resolutions over 1,200x1,080 are a bit more complex. If your graphics card or integrated graphics supports the latest HDMI 1.4 standard, you should be

fine to connect your monitor using HDMI. DisplayPort is another good option for high-resolution connections, or you can use a dual-link DVI output. **B**

If your monitor only supports VGA inputs, your motherboard should provide one. Your graphics card probably won't have a dedicated VGA output, but you can still hook up your monitor via a DVI-I output, which includes the extra pins for carrying the analogue VGA signal. A DVI-to-VGA converter is often included in the graphics card box.

HOW TO

INSTALL AN OPERATING SYSTEM

STEP 1 CREATE A BOOTABLE FLASH DRIVE

If you're installing an operating system from a CD/DVD, such as a Windows 8 retail pack, you can ignore this step and proceed to Step 2. If you're planning to install an operating system from a hard disk or USB flash drive, however, you'll need to set it up as a bootable drive with an operating system installation on it. You'll need to use another PC to set it up.

Windows

Windows 8.1 is the best operating system to install right now, and you'll get a free upgrade to Windows 10 when it's available. You'll need to have a full retail copy to install it on your new PC; an old product key and restore disc from a previously bought PC or laptop won't be licensed for use on your new hardware.

If you have an old retail copy of Windows 7 (again, not a copy that came installed on another PC or laptop), then that will suffice as a stand-in operating system until Windows 10 launches later this year. Just be sure to install all the security updates via Windows Update before you start browsing online.

If you've lost or scratched your retail Windows install disc, then you can download an ISO image of it from Microsoft and create a new one. To do so, follow our instructions at tinyurl.com/cswindowsiso.

Other operating systems

Our favourite software for setting up a bootable USB drive using .ISO files for other operating systems is Rufus (rufus.akeo.ie). Be sure to have a storage drive large enough for your operating system; 8GB should be enough. Also ensure there's nothing already on the drive that you might need, as it will be wiped to store the operating system and you'll lose your existing data.

In Rufus, select your destination USB flash drive from the dropdown menu at the top. If your motherboard was made within the last few years, you can leave Rufus set to using a GPT partition scheme. Tick the box labelled 'Create a bootable disk using' and select 'ISO' from the dropdown menu. Next, click the disk icon and select the .ISO file you downloaded. Now click 'Start' and Rufus will create a bootable flash drive with your operating system of choice.

STEP 2 BOOT FROM INSTALLATION MEDIA

Whether you're installing from a CD/DVD or a flash drive, you'll need to have your system boot from the correct installation media. Turn on the system and immediately look for

an option to access the Boot Menu. This is often F12 on many motherboards, but consult the instruction manual. Select either the USB flash drive or the optical drive, depending on where you want to install from.

If you can't find an option for the boot menu, you can change the boot priority in the main BIOS itself. This is usually accessed by pressing Del as the system starts up. Press Del repeatedly to be sure of entering the BIOS. Navigate to the storage menu and look for an option to set Boot Priority #1 to whichever storage media you want to install from.

If you use this method, you might need to go back into the BIOS after you've installed the operating system to change Boot Priority #1 to the hard disk or SSD where you've installed the operating system.

FREE OPERATING SYSTEMS

WINDOWS 10

If you're not currently looking to spend money on an operating system, the Technical Preview of Windows 10 is available for free, although no longer directly from Microsoft. Mirrors such as www.windows10update.com exist, but we can't vouch for the security of ISOs downloaded from these sources.

As this is a technical preview, there may be bugs and other issues ahead of its full release. The good news is that Microsoft has said that anyone who has legitimately purchased Windows 7 or Windows 8.1 will get a free upgrade to Windows 10 within its first year of release, so it might be worth buying Windows 8.1 in the meantime.

ELEMENTARY OS

There are plenty of free Linux distributions available but our current favourite is Elementary OS (www.elementary.io), which is an open-source operating system based on Ubuntu Linux.

STEAMOS

If you're looking to create a high-end system purely for gaming, you can install an early version of the SteamOS operating system (store.steampowered.com/steamOS/buildyourown). However, bear in mind that you'll be limited to games from the Steam service that support Linux, unless you want to stream games from another Windows-based PC.

HOW TO

TROUBLESHOOT PROBLEMS

So you've put everything together and excitedly turn on the PC... but it doesn't boot up. Don't panic, though. Go through the following troubleshooting steps and you may find that the solution is surprisingly simple.

PC WON'T POWER ON OR BOOT UP

Check the PSU is turned on

This might sound obvious, but it's happened to the best of us. There's often a separate power switch on the PSU itself. Make sure this is switched to the 'on' position before attempting to boot up the system from the case's front panel power button. Also check you've turned the PC on at the plug, and try a different socket.

If you've checked everything else, try a different power cable (your kettle may use the same type) or check the fuse in the plug.

Check the front panel connections

If the front panel's power button isn't correctly connected to the relevant headers on the motherboard, the power button won't work. Check you've connected the Power connection to the correct header (see page 111).

Remove USB devices

Occasionally, motherboards will refuse to boot if devices are connected to specific USB ports. Try disconnecting any connected USB devices or peripherals, such as a keyboard and mouse,

and try booting up the system again. If it boots correctly, it will ask you to connect a keyboard and mouse. Do so, but this time try a different USB port.

Check components are seated correctly

Look at the motherboard and check that all the individual components are correctly seated in their slots. Start with the memory. Improperly seated memory is often a cause of a boot failure. If you have multiple sticks of RAM, try installing only one at a time to isolate if any of the modules are faulty. If that doesn't solve the problem, check the processor and graphics card, if you have one installed.

Check the power cables

Make sure the power cables are connected to all the components correctly. You might have missed the secondary four- or eight-pin power connector to the motherboard, for example.

If you've installed a graphics card, make sure it has the necessary power cables from the PSU. Any SSDs or hard disks will also need separate power connections.

Listen for the beeps

If the components such as processor fan and graphics card are powering on but the system won't POST (power-on self-test), the motherboard might provide an error code beep if you have the case's built-in speaker connected to the header. Look through the instruction manual for your motherboard or do a search online to see what the different beeps mean. This will help you diagnose any problems. Some motherboards may also have a small LCD display that can display error codes making the task even easier.

NO IMAGE ON MONITOR**Check the connection**

Make sure the display cable is correctly connected to both the PC and the display. If you're using DVI or VGA (D-sub), be sure to screw in the connectors so they don't come loose. If you're using a dedicated graphics card, make sure the cable is connected to the graphics card and not the integrated graphics output on the motherboard. You may need to change settings in the BIOS to ensure your PC is using the right outputs; you can do this in the BIOS (see 'Boot priority', below).

Check the display input


If your display has more than one input, make sure it's set to display the right one. This will be whichever connection is used on the display itself, so if you've used a DVI-HDMI cable and you've connected to the HDMI port, set it to HDMI. Do the opposite if the cable is reversed.

OPERATING SYSTEM WON'T LOAD**Boot priority**

Your BIOS might be set to boot from a secondary storage disk, USB flash drive or optical disc rather than your system disk, which has the operating system installed on it. You'll need to change the boot priority so that the PC boots the system disk by default by going into the BIOS.

You can usually enter the BIOS by booting up the system and pressing Del repeatedly. Consult your motherboard's manual if this doesn't work. Once in the BIOS, look for a menu referring to the storage disks. You'll want to change the boot priority order so that the system disk is Boot Priority #1, meaning that the PC will use this storage device first.

Operating system isn't installed

If you've forgotten to install the operating system, or it hasn't installed correctly, then follow the instructions on installing an operating system, opposite. 

RECOMMENDED BUILDS

Now you've got the know-how when it comes to putting together a PC, we've recommended three systems you can put together based on your needs, whether it's a budget family PC, a mid-range workhorse or a high-end system capable of playing the latest games.

HIGH-END PC

This high-end gaming system is housed in an attractive Corsair Obsidian Series 450D case that has plenty of room inside for a large graphics card. The Intel Core i5-4670K processor provides great performance, and you can overclock it if you want to squeeze a little extra out of it. A fast SSD for your system disk will keep things feeling responsive, and there's a 2TB hard disk for your media. The XFX 850W PSU will leave you lots of headroom for future upgrades as well. Add the Best Buy-winning XFX Radeon R9 280X Black Double Dissipation Edition graphics card for playing games and you've got a top performer for the money that will handle most of today's games.



CASE Corsair Obsidian Series 450D
£98 • www.scan.co.uk

MOTHERBOARD ASRock Z97 Extreme6
£141 • www.ebuyer.com

CPU Intel Core i5-4670K
£190 • www.ebuyer.com

GRAPHICS CARD XFX Radeon R9 280X Black Double Dissipation Edition
£182 • www.scan.co.uk

RAM Corsair Vengeance 8GB 1,600MHz DDR3 Memory
£53 • www.ebuyer.com

SSD Crucial MX100 256GB
£100 • uk.crucial.com

HDD 2TB Western Digital Green
£65 • www.ebuyer.com

PSU XFX Pro 850W XXX Edition
£72 • www.ebuyer.com

TOTAL (excl. display, peripherals and OS) £901
Without graphics card £719

MID-RANGE PC

This mid-range PC uses the NZXT Source 340 case, which we like because of its no-fuss, clean design. The Intel Core i3-4160 processor is a decent performer for a reasonable price and, paired with the 256GB Crucial MX100 SSD, the system will feel nice and responsive. There's also a 1TB mechanical Western Digital Green hard disk for storing the rest of your media. If you're happy to play games at medium graphics settings, the optional Gigabyte GeForce GTX 750 Ti OC graphics card will have you covered.



CASE NZXT Source 340
£60 • www.scan.co.uk

MOTHERBOARD Asus Z97-E
£101 • www.dabs.com

CPU Intel Core i3-4160
£88 • www.ebuyer.com

GRAPHICS CARD Gigabyte GeForce GTX 750 Ti OC
£116 • www.scan.co.uk

RAM Corsair Vengeance 8GB 1,600MHz DDR3 Memory
£53 • www.ebuyer.com

SSD Crucial MX100 256GB
£100 • uk.crucial.com

HDD 1TB Western Digital Green
£45 • www.ebuyer.com

PSU XFX Pro 850W XXX Edition
£72 • www.ebuyer.com

TOTAL (excl. display, peripherals and OS) £635
Without graphics card £519

BUDGET FAMILY PC

You can build a capable PC for day-to-day computing tasks without spending a lot of money. The SilverStone case is great value and quiet in operation. We also liked the bargain AMD A6-7400K processor when we reviewed it last month. Its performance won't set the world alight, but it will be fine for everyday tasks and its integrated graphics will even allow for some light gaming, making it a great choice for Minecraft and the like to keep younger family members entertained. There's also plenty of storage capacity for your family photos and videos as well.



CASE SilverStone Quiet Precision PS11
£41 • www.scan.co.uk

MOTHERBOARD ASRock FM2A88X Pro3+
£55 • www.lambda-tek.com

CPU AMD A6-7400K
£48 • www.ebuyer.com

RAM Corsair Vengeance 8GB 1,600MHz DDR3 Memory
£53 • www.ebuyer.com

HDD 2TB Western Digital Green
£65 • www.ebuyer.com

PSU Be Quiet! Pure Power L8 530W
£62 • www.scan.co.uk

TOTAL (excl. display, peripherals and OS) £324

All prices include VAT



eLECTION

2015

Why can't we vote online?

You can do pretty much anything online these days, but voting has barely changed since the 19th century. As Britain prepares to go to the polls again, **Simon Handby** considers the case for casting your ballot online

It's unlikely to have escaped your notice that on 7th May we'll be heading to the polls for the 2015 general election. The issues, personalities and policies may (arguably) change, but the way we vote in the UK certainly hasn't. We'll be marking our choice on the ballot paper in the usual way – yet these days we can do everything else online. So why aren't we choosing governments from the comfort of our laptops? In this feature we look at the technology of voting, and at the changes technology is bringing to elections and politics.

Spoiled paper

For most of us, it won't be a great hardship to swing by a polling station on 7th May, but when we get there we'll be presented with a scenario that would be recognisable to our great-grandparents: after identifying ourselves we're presented with a ballot paper on which we mark a cross, then we fold it, post it in a ballot box and go home to await the result. Ballot boxes are collected and transported to a central counting location, where volunteers and officials sort and count their contents by hand; a constituency's result isn't usually known until at least a couple of hours after the poll has closed.

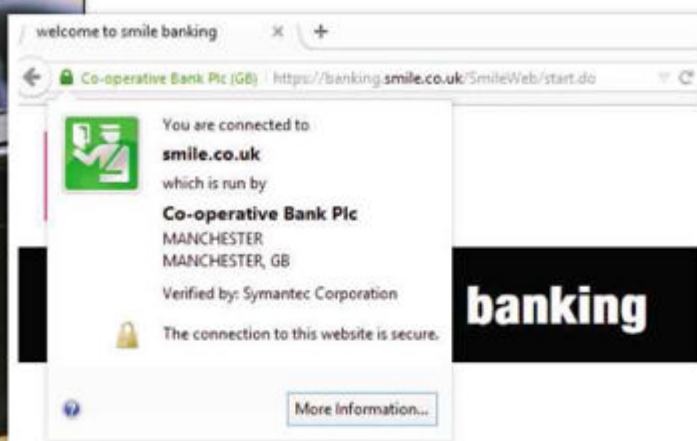
In an age when we can provide detailed financial records to the taxman via an online form, or transfer thousands of pounds safely with a mobile app, our paper-based, labour-intensive voting system looks increasingly out of date; indeed, it was introduced with the Ballot Act of 1872. However, before we write it off, it's important to consider its strengths. A free and fair election requires that only those entitled to vote should do so, that they should each do so only once, and that they should be able to do so in privacy and without fear of coercion or reprisals.

Currently, in theory at least, each voter proves they're eligible to vote by identifying themselves, and their name is crossed off the list of voters so they can vote only once. Although a record is kept linking each voter's elector number to their ballot paper number, it's sealed at the close of polls and can't be



It may be dated, but a paper ballot is effective at protecting the privacy of our vote

Reproduced with kind permissions of the Electoral Commission



↑ If it's good enough for the bank...

opened without a court order, preserving the anonymity of our votes unless the election's validity is challenged. As such, we need have no fear of reprisals. By splitting the vote across multiple polling stations, each manned by multiple officials and using multiple ballot boxes, the potential impact of any accident or subterfuge is comparatively limited.

However, concerns about the accessibility of voting and falling voter turnout has led to a relaxing of the rules on proxy and postal voting: since 2001, anyone can apply for a postal vote without giving a reason. Unfortunately, it soon emerged that postal voting in particular was subject to malpractice: in 2005, five men were found guilty of a large-scale fraud involving thousands of postal ballots, in the Birmingham local elections of June 2004.

While changes to the system have subsequently made it more secure, remaining criticisms include that it is far too easy to create fake or duplicated entries on the electoral roll, a practice known as 'roll stuffing'.

The technology problem

It's easy to assume that modern technology would provide the perfect answer. An ideal electronic system would certainly bring advantages: the electorate could vote from a polling station, but also from home, work, or anywhere they could get a data connection. Results could be tabulated and calculated automatically and centrally, providing a near-instant result and reducing the logistics and cost of an election. With fewer staffing and location concerns, polls could stay open longer, increasing turnout.

But implementing such a system is far from straightforward, and getting it wrong could have grave consequences.

A successful hack on an electronic system could change the result of a general election

While many consider our current voting arrangements too susceptible to fraud, a successful hack on an electronic system allows a far more insidious and widespread manipulation of the poll; in the worst case, changing the result of an entire general election.

We spoke to Dr James Heather, a computer security expert with a particular interest in electoral security, who stressed that internet voting, and

electronic voting within the polling station, present two quite different challenges. Heather thinks the greatest challenge lies in internet voting, which poses a different problem to, say, the secure exchange of information with your bank: "When you do your online banking, you're trying to protect information that's going between you and the bank. But everything you know about your bank account, the bank also knows: there's no secret between you and the bank."

Heather contrasted this with internet voting: "I'm not interested in getting my vote to the returning officer so that only me and the returning officer know how I voted. What I want to do is to get my vote into the system so that it can be included in the count without anybody knowing how I voted."

According to Heather, this means a voting system can't just encrypt your vote, send it to a returning officer for decryption and trust they won't share it with a third party. Certainly, without any attempt to decouple the identity of the voter from the vote they cast, voters could be open to reprisals.

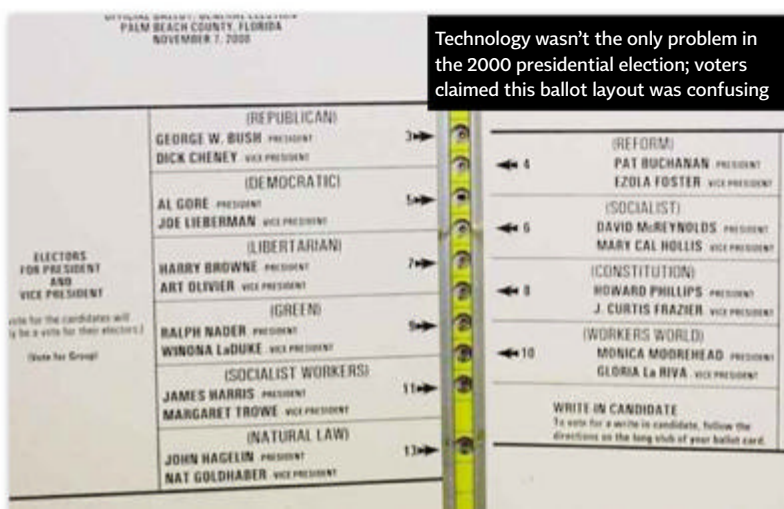
Some kind of shuffling of an electronic vote is needed, then, much as ballot papers become shuffled in the ballot box before they're counted. It's here that we should introduce another requirement of the ideal voting system: each voter should be able to verify that

REGISTER TO VOTE



In 2014, the government scrapped the previous 'head of the household' voter registration system, where a single respondent would register and confirm all those living at an address who were eligible to vote. It's now the responsibility of individuals to ensure their name appears on the electoral register, a change which critics say has led to a drop in registration, particularly among first-time voters.

If you're unsure whether you're registered to vote, the first step is to check with your local council's electoral services department, which is responsible for maintaining the register. If you're not registered, or if you want to apply for a postal, proxy or overseas vote, visit www.aboutmyvote.co.uk urgently.



their vote has been correctly received and counted, and potentially change their vote up until the close of polls.

Unhappy returns

With the perfect electronic system in mind, it's instructive to look at earlier attempts at electronic voting and vote counting around the world. The most notorious example is the 2000 US presidential election in Florida, which put George W Bush in the White House. Various post-election studies revealed multiple issues with the state's vote, affecting both candidates, including poorly designed ballot papers and badly written instructions to voters. However, two of the biggest problems arose from automated voting machines, which produced the infamous 'hanging chads', and counting machines that mis-categorised or incorrectly rejected thousands of votes.

Concerns have since been raised over electronic voting machines, which record voter intent through either push-button or touchscreen interfaces. The US has used such machines quite extensively, but in 2009 the Argonne National Laboratory in Illinois demonstrated a successful, apparently simple man-in-the-middle attack on a Sequoia AVC Advantage e-voting system, as used in New Jersey. In 2011 the same team demonstrated similar vulnerabilities in a Diebold AccuVote touchscreen system. In both, votes for one option appeared to have been registered correctly, but were manipulated so that the machine in fact recorded an alternative option.

In Ireland, experiments with electronic voting were disastrous. In the 2002 general election, electronic systems made by Dutch firm Nedap underwent trial in three constituencies, with a view to rolling similar technology out nationwide. However, a subsequent Department of Environment report raised concerns that the integrity of the ballot couldn't be guaranteed with the equipment and controls in place, and that voters could be duped into voting for the wrong candidates if a fake ballot was simply taped over the machines' front panels.

In 2006, Dutch hackers claimed to have reprogrammed a Nedap ES3B voting machine – used in Germany, France and the Netherlands – such that “anyone, when given brief access to the [device] at any time before the election, can gain complete and virtually undetectable control over the election results”. Also of concern, they claimed that radio emanations from an unmodified machine could be read to reveal the vote cast. In 2012, after many years in storage, Ireland's voting

BLANK CANVAS

How technology helps politicians engage

Many of us will have been visited by party workers, councillors or even MPs in the run-up to an election, as they attempt to gauge support and mobilise voters in key constituencies. This year will be no different, but such face-to-face canvassing is part of a wider effort, one in which parties hope that the latest tools and platforms will give them an advantage.

These days, social platforms such as Twitter and Facebook are a must for politicians seeking to engage with the electorate, with central party offices typically also using YouTube, Google+ and Instagram. We contacted Labour, the Conservatives, the Liberal Democrats, the Green Party and UKIP to ask for details of the teams manning such accounts, and whether – as is common with larger businesses – they were supported by external, digital agencies. All declined to comment.

We were also keen to discuss the use of software for tracking and mobilising support, such as NationBuilder – an internet community-building service cited by US Democratic Party members as their most important advantage over Republicans in the 2012 US presidential election. As Willard Foxton, blogging for the *Telegraph*, explains: “[NationBuilder] doesn't stop the grind of an election campaign – the door knocks, the rallies, the speeches – but what it does is link online and offline, making sure online campaigning leads to targeted offline follow-up.”

The software allows campaigners to build detailed profiles of potential supporters and use these to target resources in the run-up to the vote. The Scottish National Party trialled the software in its Scottish Parliamentary election victory of 2011, and UKIP, Labour and the Liberal Democrats are using it now, but no-one we contacted would discuss exactly how.

A Labour Party spokesperson did explain that the party's aim was to engage people through social media, “rather than to broadcast at them”, and that “we try to bring political issues to life by creating personalised digital experiences that engage users”.

“Digital campaigning doesn't exist in a silo,” they added. “Everything we do is focused on winning votes in the real world, by encouraging supporters to take action as a result of our content.”



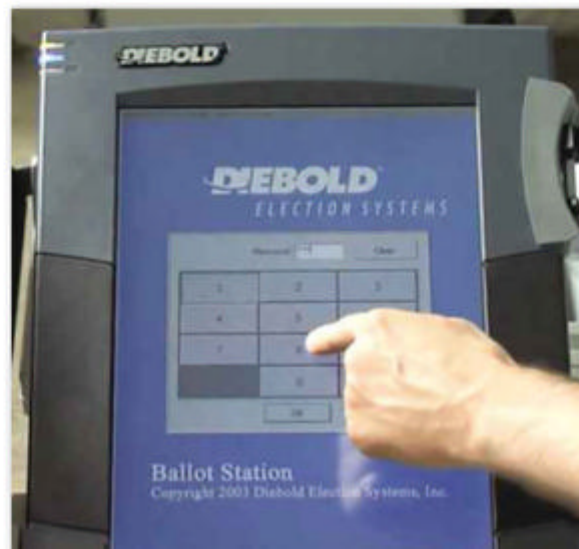
↑ Not the kind of engagement that the Labour Party was looking for from its digital presence

machines were scrapped. The project had cost an estimated €55 million.

Trial and error

Nothing so dramatic has happened in the UK, but attempts to modernise the way we vote have been ongoing for a while. In addition to the 2001 changes to postal and proxy voting, the government began encouraging local authorities to run pilots of alternative voting methods, including electronic voting. Of participating authorities, Sheffield City Council and Swindon Borough Council have undertaken the

↓ The Argonne National Laboratory released a video demonstrating a successful hack of a Diebold electronic voting machine



most systematic pilots, at local elections in 2002, 2003 and 2007.

Announcing the 2003 trials, then local government minister Nick Raynsford claimed the scale of the 2002 pilots was such that “the UK is rightly regarded as being among the pioneers of electoral modernisation”. In the 2015 general election, however, there will be no electronic voting, so what exactly went wrong?

In Raynsford's defence, he made clear that new technology would proceed further only if the government was satisfied it was secure and robust. In 2007, the Electoral Commission – which oversees elections in the UK – recommended electronic voting should be halted on the grounds that security and implementation would need to be improved before it could move forward. While acknowledging the commission had learned much from pilots, its then chief Peter Wardle said: “We do not see any merit in continuing with small-scale, piecemeal piloting where similar innovations are explored without sufficient planning and implementation time, and in the absence of any clear direction, or likelihood of new insights.”

According to some, it's a good thing we haven't moved forward. Dr Stuart Wilks-Heeg, head of politics at the University of Liverpool, explained that, since 2007, "evidence of profound problems with the security of e-voting has emerged internationally".

"For example, in 2013, hackers showed how it was possible to access Geneva's e-voting system for referendums to change a 'yes' vote to a 'no', and vice versa. Also in 2013, French journalists were able to cast fraudulent votes in an open primary to select the [opposition] UMP's candidate for the Paris mayoral election."

Such interference, together with the aforementioned man-in-the-middle attacks, are deeply worrying, but Dr Wilks-Heeg raises a more ominous threat: that a foreign power could launch an orchestrated attack on a vote through a central weaknesses in the system, or via malware.

Where there's a will

Against this backdrop, it's perhaps understandable if the enthusiasm of Tony Blair's Labour government for "an e-enabled general election some time after 2006" has evaporated somewhat. The loss of the 2011 referendum on the Alternative Vote dampened the present government's enthusiasm for reform of our electoral mechanism, even if – as several experts pointed out – reform of the electoral system and of electoral technology are two different things.

However, the will to implement electronic voting does appear to be building again. In November 2013, the Speaker of the House of Commons,



↑ In Smartmatic's Belgian system, electronic machines produce a paper ballot slip

John Bercow, set up of the Commission on Digital Democracy (CDD), which released its final report in January 2015. It recommended that by 2020, not only should "secure online voting... be an option for all voters", but that an "interactive and digital" parliament should experiment with ways for the public to put questions to ministers and contribute to the law-making process.

Given the current lack of momentum, it seems unrealistic to expect that an internet voting system could be implemented by the time of the next general election. Dr Wilks-Heeg spoke of a consensus among experts that it would take at least 10 years to ensure that internet voting was secure from fraud or hacking. There are many companies offering electronic voting systems for the polling station, but Dr James Heather cautioned that "[there is a distinction] between what's commercially available,

and what has been designed and subjected to some academic rigour".

For their part, the makers of electronic voting machines argue that security has improved hugely since the last UK trials. Smartmatic, a London-based voting systems company, told us its voting platform "was designed, from the beginning, by taking into account all possible physical and electronic threats a voting system might be exposed to". For example, configuration data and votes are encrypted within the voting machine so they can't be read or modified, which ought to rule out a man-in-the-middle attack.

Belgian waffle

Smartmatic is keen to highlight its role since 2012 in parliamentary, local and European elections in three regions of Belgium. In that system, voters arriving at the polling station are identified and issued with a smartcard that will enable

A TIDY EXIT Why we know the result before it's announced



For hours after an election we rely on exit polls, which are often wide of the mark – notably in 1992, when a hung parliament was predicted ahead of a Conservative majority. To address such inaccuracies, from 2005 the BBC and ITV agreed to pool their data for a single exit poll.

Since then, you might as well have gone to bed at the close of voting, with the 2005 exit poll correctly predicting a 66-seat Labour majority, well before a single constituency had declared. In 2010, the poll correctly predicted a hung parliament with 307 seats for the Tories; in the event they won 306. Many commentators raised eyebrows at its forecast of a poor 59 seats for the Liberal Democrats, given their strong position in opinion polls immediately before the vote. In the event, however, they won just 57 seats.

We spoke to John Curtice of the University of Strathclyde and head of the team responsible for the poll, who explained its data gathering is conducted at around 130 locations by means of a paper ballot and ballot boxes, similar to the actual vote. Researchers count the results, then forward it to the team for subsequent modelling.

Curtice poured cold water on our suggestion that the poll's recent accuracy might be down to improving technology, explaining instead that as much as possible, samples are taken at consistent polling locations between elections. With a record of how a

location's previous exit poll and results compare, it's possible to make a more accurate estimate of what the latest poll represents. From that, the team can derive a more accurate estimate of what the outcome might be across the country.

Curtice explained that the accuracy of the 2010 prediction for the Lib Dems was just down to the data, or "simply a case of asking people what they did and not getting many more people [voting Lib Dem] than five years previously". Accurate data was behind the Tory prediction, too, but in this case the team also spotted that Labour was performing better than anticipated in Scotland and in areas with a high ethnic minority population, and used this to reduce the estimate of overall Conservative seats.

Poll calculations are probabilistic, which is to say that the team calculates the likelihood of the possible outcomes in each polled location, and creates a nationwide model using these. Curtice explained that in the 2015 election this approach would be vital in predicting the UKIP vote: "We'll get an awful lot of seats where UKIP might have a five or 10 per cent chance of winning, and as a result of that, somewhere or other UKIP are going to pick up a seat. Don't ask us which one it is – it could be one of 10 possible places – but we suspect that somewhere or other they'll strike lucky."

them to activate a standalone touchscreen voting machine. Once they have made their selections, the machine prints a paper record of the vote, containing all the selections in plain text together with a QR code representing them. Voters must post this in an electronic ballot box, which stores the paper vote, but also reads the QR code and transfers the data to the central 'president machine'. Votes are encrypted, stored on two USB drives, and the voter returns their de-activated smartcard before leaving.

Smartmatic says its solution was chosen after a two-year process involving authorities, universities and PricewaterhouseCoopers. Among the system's advantages is that the identification of voters is achieved separately from their vote: the smartcard serves only to authorise a vote, rather than identify the voter to the voting machine. There's also a paper trail to assist in auditing. However, the system doesn't allow voters to verify that their vote has been received and counted.

Smartmatic also offers the example of Estonia, where since 2005 the electorate has been able to vote via the internet in a system originally developed by the Estonian company Cybernetica, and the Estonian National Electoral Commission (VVK). In that year only 9,317 people chose to vote online, but in the most recent Parliamentary elections in March, this had risen to more than 176,000 people – 30% of all votes cast.

In the Estonian system, voters have seven days in which to cast a vote online. In order to vote, they must install a digitally signed app from the VVK website, then verify their identity using either their digital ID card – a biometric card issued to Estonians since 2002 – or with a security code sent to their mobile phone. Once identified, the voter can make their selections from an electronic ballot,



Andrus Ansip, former Estonian prime minister, casts his vote online

and must verify their identity again before submitting it.

Let me see your ID

We asked Smartmatic how the Estonian system ensures that a vote is separated from a citizen's identity. Michael Summers, the company's internet voting director, told us: "The principle is rooted in the double-envelope system used for traditional postal voting in some countries. An inner 'virtual envelope' contains the encrypted vote, and the outer virtual envelope is digitally signed. Before counting occurs, both envelopes are separated.

"The [outer] envelope with personal data is discarded after its mission of conferring the eligibility of the voter and authenticity of the vote. The [inner envelope] is sent to the digital ballot box. The encrypted, anonymised votes are then cryptographically 'shuffled' to randomise the casting sequence, and are then transferred to a 'clean', air-gapped counting server, where they are decrypted by a quorum of election officials."

Despite the apparent security of this approach, however, in 2014 a team at the University of Michigan conducted what it described as an independent evaluation of the system, concluding that it had 'serious design weaknesses... exacerbated by weak operational management' and that its use should be discontinued. In response, VVK stated that the system had been used in six elections without "a single incident [that had] influenced the outcome", but the researchers disagreed. You can read further discussion about the system at tinyurl.com/shopperestonia.

What's certain is that, like other remote voting arrangements including postal voting, Estonia's system is susceptible to small-scale,

unsophisticated attacks. In essence, as Dr James Heather puts it: "Whatever security measures you have for encrypting things, there's just no way of knowing that there isn't somebody standing behind me with a baseball bat while I'm voting."

Vote of confidence

In the internet age the UK's paper-based, labour-intensive elections are an anachronism, but it appears this isn't just down to a lack of political will. Implementing secure systems that prevent fraud yet protect the anonymity of our vote is a huge and expensive undertaking, and questions remain about even the most successful implementations to date worldwide.

In addition to these concerns, there's scant evidence to support arguments often raised in favour of electronic voting, and internet voting in particular. Most significantly, many studies appear to suggest that the

There's scant evidence to support arguments often raised in favour of electronic voting

availability of internet voting results only in a small improvement in turnout; in most cases, people who voted online say that they would have voted by other means if necessary.

Analysing turnout after the increased availability of postal votes in the 2005 general election, Professor John Curtice (see 'A Tidy Exit', opposite) wrote: "Not even the prospect of [avoiding] the journey to the polling station enticed many voters to exercise their franchise."

He added: "Turnout depends not on giving people a choice about how to vote, but rather on what they are voting about." 🗳️



British democracy has come a long way since the Palace of Westminster was finished in 1870, but we think it can come further

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How to...

Create a home inventory spreadsheet

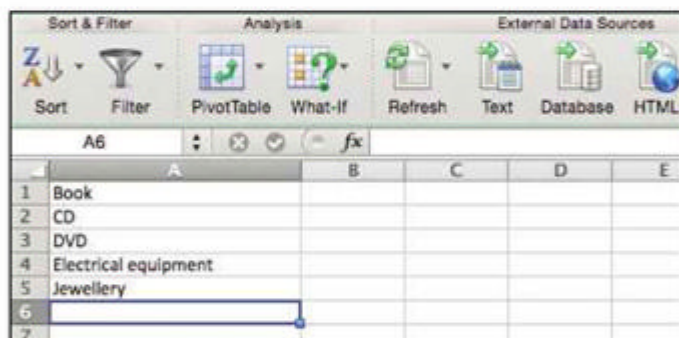
Excel is great for making sense of and categorising data, as **David Ludlow** shows you with this guide to keeping track of your home's contents

EXCEL IS BRILLIANT for organising and sorting large amounts of data. In this guide we'll show you a few techniques as we build a home inventory spreadsheet. First, we'll explain how to ensure that you get consistent entries with data validation; then, we'll show you how to

count how many entries of a certain type you have using the Countif function; and finally, we'll show you how Sumif lets you add up values based on your criteria. All the techniques can be applied to your own spreadsheets, and you'll soon see how powerful they can be.

01 SET UP YOUR RANGE OF VALUES

Create a new spreadsheet and click the plus button at the bottom of the window to create a new tab. Right-click the tab, select Rename and enter a name for this tab (we've chosen Type). Starting in cell A1 and moving to cell A2, then A3 and so on, enter the values that you want to appear in the drop-down menu. For our spreadsheet, we've gone with categories of item in the house (CD, DVD, book, electrical equipment and so on). Don't worry if you forget something, as you can add it later. Click A to select the entire column and click Sort to sort your list alphabetically, making it easier to select a value. Note that you don't need to create this list in a new tab – it can be created anywhere in the spreadsheet – but it keeps everything neat.



03 SET UP VALIDATION

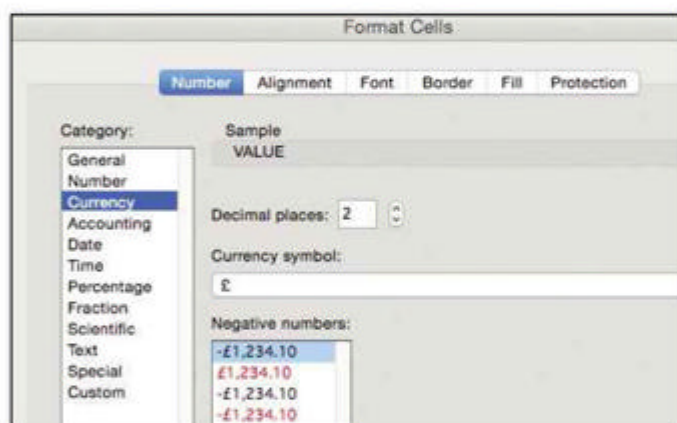
To set up your validation click column B, then the Data tab and finally Validate. From the Allow menu, select List (the other options let you restrict entry by setting limits for dates, numbers, text length and so on, but don't give you a drop-down menu). Click the icon next to the Source entry box and then, in your spreadsheet, click the Type tab (or whatever you called your second tab) and click A to select all your data. You can select just the list instead, but if you then want to add new items to it, you'll need to repeat this step and reselect your new list.



Hit Enter to confirm and then click OK. At the moment, validation is also turned on for the cell header, which you don't want. Click B1, click Validate and select Any value from the Allow menu, then click OK.

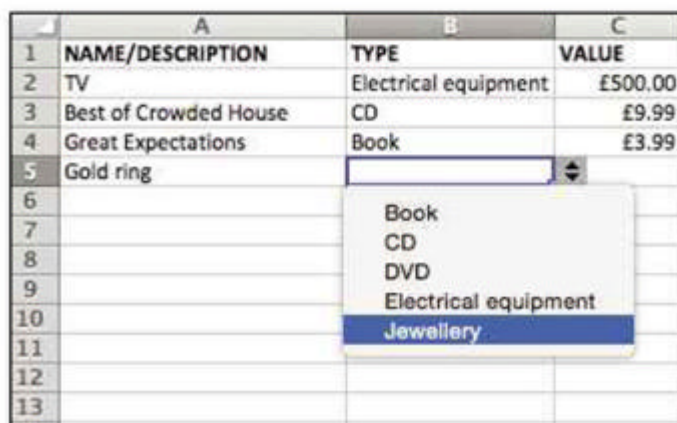
02 SET UP YOUR SHEET

Click on Sheet1 to go back to the main sheet. In cells A1, B1 and C1, we've entered the headers Name/description, Type and Value respectively. We've also used bold to make them stand out. To make the value column display everything in pounds, click C to select the entire column, right-click and select Format cells. Click the Number tab, select Currency, make sure that it's set to £ and click OK.



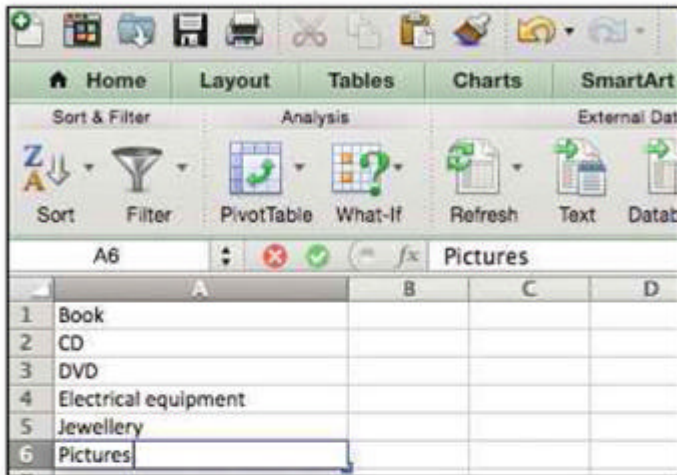
04 START ENTERING DATA

You can now start entering data into your spreadsheet. You'll notice that when you click on a cell in column B you get a drop-down menu, which only lets you enter data from the list you input into the second tab of your spreadsheet. Excel will not let you enter any other data.



05 GROWING THE VALIDATION LIST

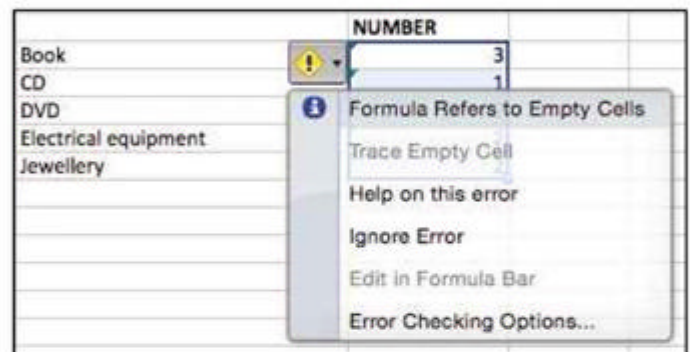
If you want to add anything to your validation list, click on the second tab and enter a new value. Don't forget to sort the list again, so that your values are easy to find. Finally, if you delete a value or change the spelling of one, your first spreadsheet will not update automatically and you'll need to make the change manually. This tip works as we selected the entire column for data validation; if you selected just your list items, you'll need to repeat Step 3 and reselect your new list.



NAME/DESCRIPTION	TYPE	VALUE			
TV	Electrical equipment	£500.00			
Best of Crowded House	CD	£9.99			
Great Expectations	Book	£3.99			
Gold ring	Jewellery	£350.00			
The book thief	Book	£9.99		Book	
Lord of the Rings	Book	£15.00		CD	
Lion necklace	Jewellery	£8.50		DVD	
Lord of the Rings	DVD	£29.99		Electrical equipment	
Gladiator	DVD	£8.99		Jewellery	
Toaster	Electrical equipment	£15.99			

06 SET UP TABLE FOR COUNTIF

You may want to count how many items of each type you have. To do this, we need to make sure that our summary table has the same headers as the list of categories. In our example, it makes sense to copy the list of categories from the Type tab and paste them into cell E6. In cell F6 we've created a header called Number.



07 CREATE THE FIRST COUNT

Countif counts how many cells in a given range have a value that matches your search criteria. What we want to do is count how many entries we have for each category type we defined, such as how many books we own. To do this, we have to fill in the Countif formula, which takes the form: =countif(<range>, <criteria>). The formula we want in cell F6 is =countif(B:B, E6). This tells Countif to look at column B in its entirety (our Type column) and count how many cells contain the value stored in E6 (in this case, Book).

TYPE	VALUE				
Electrical equipment	£500.00				
CD	£9.99				
Book	£3.99				
Jewellery	£350.00				
Book	£9.99		Book		
Book	£15.00		CD		
Jewellery	£8.50		DVD		
DVD	£29.99		Electrical equipment		
DVD	£8.99		Jewellery		
Electrical equipment	£15.99				

08 IGNORE EMPTY CELLS

You'll see that the value in F6 is now the number of books that we own. Adding extra rows into the main sheet will increase this count every time a new book is added. Click cell F6, then click and drag the square in the bottom right-hand corner down until you reach the bottom of your list. This will replicate the formula downwards, giving you a count for each category of item.

You'll also see that there's a green triangle at the top of each cell, which lets you know that there's a warning. In this case, Excel is telling you that the formula is looking at empty cells. That's fine in this case, as we want the freedom to add new rows and have the Countif function updated. Select all the cells with this error, click the exclamation mark icon and select Ignore Error.

Countif counts how many cells have a value that matches your search criteria

09 USE DIFFERENT CRITERIA

By default the criteria of Countif defaults to '='; however, you can use different operators, such as greater than (>) or less than (<) if you're looking for numerical values. For example, we could search our spreadsheet for high-value items (for example, more than £250) to see how many we owned. To do this, in E3 enter 'High value items'. In cell F3 enter the formula =countif(C:C, ">250"). This searches the Value column and counts how many entries are greater than £250 (note that you don't need to enter the pound sign in the formula, but you do need the quote marks). Tell Excel to ignore blank values, as in Step 8.

TYPE	VALUE				
Electrical equipment	£500.00				
CD	£9.99				
Book	£3.99				
Jewellery	£350.00				
Book	£9.99		Book		
Book	£15.00		CD		
Jewellery	£8.50		DVD		
DVD	£29.99		Electrical equipment		
DVD	£8.99		Jewellery		
Electrical equipment	£15.99				

10 USE COUNTIFS TO PUT IT ALL TOGETHER

While Step 9 tells us how many high-value items we have in total, it doesn't give us a breakdown by category. If we want to do this, we need to use the Countifs formula, which lets you specify multiple ranges and criteria. It works like this: =countifs(<range1>, <criteria1>, <range2>, <criteria2> and so on). Only cells that match all of the ranges and criteria are counted.

In our example, create a new header in G5 called 'Number of high value items'. In cell G6, enter the formula, =countifs(B:B, E6, C:C, ">10"). The first part of the formula (B:B, E6) counts the cells that match the category type; the second part (C:C,

TYPE	VALUE	NUMBER OF HIGH VALUE ITEMS
Electrical equipment	£500.00	
CD	£9.99	
Book	£3.99	
Jewellery	£350.00	
Book	£9.99	
Book	£15.00	
Jewellery	£8.50	
DVD	£29.99	
DVD	£8.99	

">10") looks for items that cost more than £10. We've lowered the limit here to account for books being cheaper. You can now replicate this formula down, editing the price limit (">10") to suit each category.

11 SET UP TABLE FOR COUNTIF

With Excel's Sumif function, you can add up the values of cells based on whether they match a given criteria. This helps you organise and compare values, helping you make sense of lots of information in an easy-to-digest manner.

Our summary table is already set up to display the number of each item and the number of high-value items. We'll just add a new column to contain the total value of all products in that category. In Cell H5 just enter Value and hit Enter.

TYPE	VALUE	NUMBER OF HIGH VALUE ITEMS	VALUE
Electrical equipment	£500.00		
CD	£9.99		
Book	£3.99		
Jewellery	£350.00		
Book	£9.99		
Book	£15.00		
Jewellery	£8.50		
DVD	£29.99		
DVD	£8.99		
Electrical equipment	£15.99		
Jewellery	£280.00		
Book	£250.00		

12 CREATE THE FIRST SUM

Sumif is very similar to the Countif function, although it has one extra parameter to it. The function looks like this: sumif(<range>, <criteria>, <sum range>). The first two parameters are the same as Countif and specify which range of cells to look at and the value they should match. The last parameter is the range of cells to add up. In our spreadsheet, in Cell H6, we'd use the function, =sumif(B:B, E6, C:C). This searches column B (our Type column) for entries that match E6 (Book, in our example). For any hit in column B, Excel looks along the same row and adds the value from column C into a running total. So, if B2 matches the search, Excel adds the value from C2 to a running total and so on down through the entire search range.

TYPE	VALUE	NUMBER OF HIGH VALUE ITEMS	VALUE
Electrical equipment	£500.00		
CD	£9.99		
Book	£3.99		
Jewellery	£350.00		
Book	£9.99		
Book	£15.00		
Jewellery	£8.50		
DVD	£29.99		
DVD	£8.99		
Electrical equipment	£15.99		
Jewellery	£280.00		
Book	£250.00		

13 FORMAT AND COPY DOWN

Your new formula only spits out a number, so right-click Cell H6 and select Format Cells, then click Currency and then OK. You can now drag the formula down to encompass all the categories in your spreadsheet. Click Cell H6, click and hold the square box at the bottom-right corner of the cell and drag down to the bottom of the list. Again, Excel will warn you that the formula is looking at empty cells, so select them all, click the exclamation icon that appears and select Ignore Error.

NUMBER OF HIGH VALUE ITEMS	VALUE
	£278.98
	£9.99

14 SELECTIVELY SUM

If you want to apply a sum to a subsection of your criteria, you can use the Sumifs function. For example, in our spreadsheet we may want to selectively add up the value of our high-value items as well. Create a new header in cell I5 and enter 'Value of high value items'.

Sumifs works like this: Sumifs(<sum range>, <range1>, <criteria1>, <range2>, <criteria2> and so on). In other words, you only get a sum when all the criteria for all the ranges are met.

In our example, to add up the value of all high value books, we'd use the formula =sumifs(C:C, B:B, E6, C:C, ">10"). This only adds up the value if the Type column (B:B) is a book (E6) and the value (C:C) is greater than £10 (">10"). You can format the cell to display currency, replicate it down to fill in the list and adjust the ">10" part to match what you consider to be a high-value item for each category.

TYPE	VALUE	NUMBER OF HIGH VALUE ITEMS	VALUE	VALUE OF HIGH VALUE ITEMS
Electrical equipment	£500.00			
CD	£9.99			
Book	£3.99			
Jewellery	£350.00			
Book	£9.99			
Book	£15.00			
Jewellery	£8.50			
DVD	£29.99			
DVD	£8.99			
Electrical equipment	£15.99			
Jewellery	£280.00			
Book	£250.00			

How to...

How to restore a Windows 8 PC or laptop to its factory settings

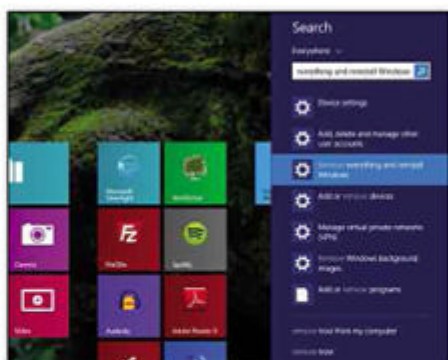
Cleaning your computer is easy with the help of the Windows 8 restore function.

David Ludlow shows you how to start afresh

THERE ARE PLENTY of good reasons to wipe your computer and put it back to its factory default settings, including selling it and protecting your private information or simply clearing out the clutter.

01 START THE RESTORE UTILITY

Go to the Start screen and type Remove to bring up the search box. In the results that appear, you'll see an option called 'Remove everything and reinstall Windows'. Click this to start the clean-up utility.



03 FIX THE 'SOME FILES ARE MISSING' ERROR

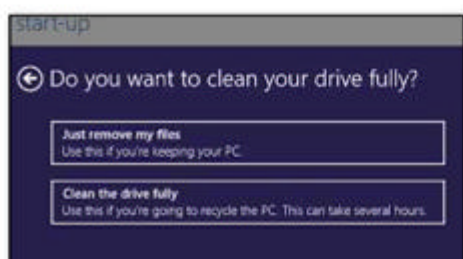
If you upgraded from Windows 8 to 8.1, you may find that you get an error message telling you that some files are missing. It tells you to insert your Windows installation disc, which you mostly likely don't have. Fortunately, there's a way round this problem.

First, follow our steps to download the Windows 8 or 8.1 installation media as an ISO file (see tinyurl.com/cswindowsiso). Next, mount the ISO file by right-clicking it and selecting Mount. Now, rerun the Remove everything utility and you'll no longer get the error message. If this doesn't work, reboot your computer, mount the ISO file that you downloaded and then run the Remove everything tool.



05 CHOOSE WIPE OPTIONS

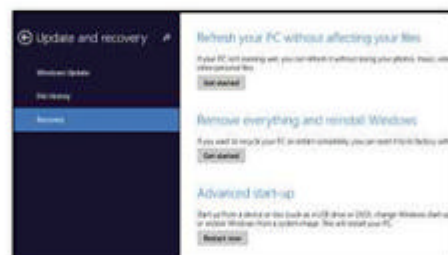
You'll now see the option to 'Just remove my files', which deletes your files but not securely; or to 'Clean the drive fully', which performs a full secure wipe. The latter option takes longer, but is the right choice if you're going to be selling your computer or throwing it away, as it stops anyone from recovering your private data.



With Windows 7 and before, doing this would require a fresh install or using the manufacturer-provided disc image. With Windows 8 things are a lot easier, as we'll show you.

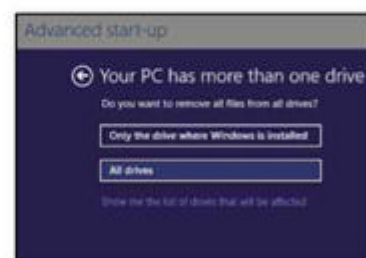
02 SELECT YOUR REFRESH OPTION

The Windows 8 app gives you two cleaning options. The first is a refresh, which will leave your personal files alone, but clears out your applications and settings; the second option removes everything and gives you a clean installation of Windows. This is the choice to make if you're getting rid of your PC, so select this option.



04 CHOOSE DRIVES TO WIPE

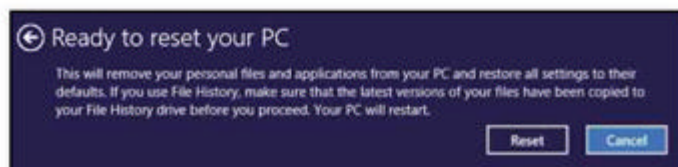
You'll get a message telling you that all your files and applications will be removed and that your PC's settings will be restored to their defaults. Click Next to continue. If you have more than one drive in your computer you'll be asked if you want to clean only the drive where Windows is installed or all drives. Select the one that applies to you. If you only have one drive, you'll be taken straight to the next option.



'Clean the drive fully' is the right choice if you're going to be selling your computer

06 RESET YOUR PC

This is your last chance before your computer is wiped. Windows will tell you what you're going to do; if you're ready, click Reset and your computer will reboot and reset itself back to its factory defaults, ready for you to start from scratch or to pass on.



How to...

Install essential free applications with Ninite

One of the most annoying things about setting up a PC is installing the programs you need. **Michael Passingham** shows you how to do it the easy way with Ninite

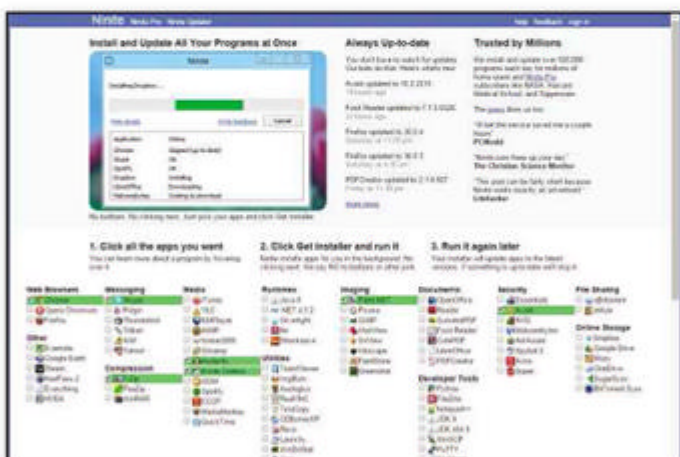
THERE'S A WEALTH of useful free Windows applications that should be installed on any new PC, but installing any of them manually can leave you with a PC full of toolbars, adware, spyware and other utilities that you really don't want. Fortunately, there's a better way using Ninite.

This clever web-based utility creates a custom unattended installer for all the applications you want on your new computer (see opposite

for a list of our top picks). Cleverly, it selects the correct version for your computer (32-bit or 64-bit) and deselects any options to install additional software or toolbars. In other words, Ninite is the safe, hassle-free way to install free software on your computer. If that's not reason enough to use it, running the installer again later will check for updates and install them automatically.

01 DOWNLOAD YOUR CUSTOM INSTALLER

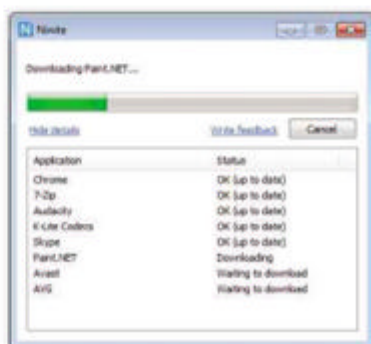
Go to the Ninite site (www.ninite.com) and you'll see a list of applications, organised by category, such as Web browsers, Messaging, Documents and Security. All you have to do is tick the box next to the applications you want and then click the Get Installer button. This will download a small executable file to your computer.



This clever web-based utility creates a custom unattended installer

03 USE NINITE TO UPDATE SOFTWARE

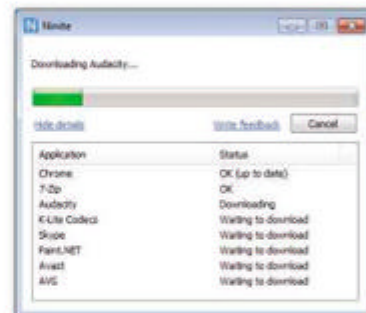
If you run the Ninite installer at any point in the future, it will check for updates to the software it installed and download and install the latest versions. This makes Ninite a quick one-stop shop for keeping your software up to date. As with the main installation, the Ninite updates won't install any toolbars or additional software.



02 INSTALL YOUR SOFTWARE

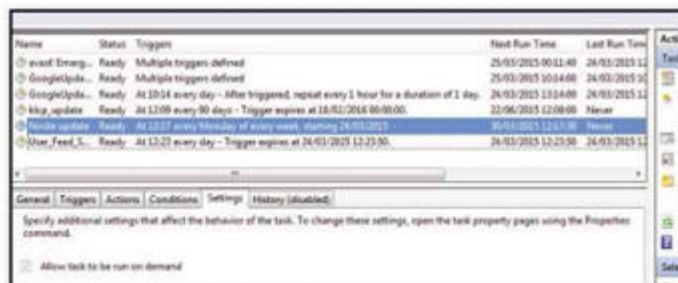
Run the file to install the software. If you want to run it on a different PC, simply copy the Ninite installer to a flash drive or email it to yourself. The file isn't locked to a particular PC, so it's a good idea to make a backup of the file to use when you need it.

Click OK on any security prompts to give Ninite the permissions it needs. Ninite will then download and install your chosen software, and you can leave it running. A progress bar shows you the current status, and you can click Show details to view the overall progress and see what has already been installed.



04 SCHEDULE UPDATES

You can run Ninite manually, but a better option is to schedule it to run weekly or monthly. To do this, copy your installer file to a folder on your hard disk, such as c:\ninite, then run Task Scheduler from the Windows Start menu. Select Create Basic Task from the Start menu and you'll open a new wizard. Name your task (Ninite update, for example) and click Next. Choose the frequency (Weekly or Monthly) and click Next. Choose the start time and the days you want to the task to run and click Next. Choose 'Start a program' and click Next, then click Browse, navigate to your Ninite installer and select it. Click Next and Finish to create the task. Finally, click on Task Scheduler Library in the left-hand pane and click your task in the middle pane. Right-click it and select Properties, then click the Settings tab and select 'Run task as soon as possible after a scheduled start is missed' to ensure the update runs if your PC was switched off at the scheduled time.



Best applications to install on a new PC

NINITE HAS MORE than 80 applications available, but you'll only need to install a fraction of them on your PC. We've hand-picked our favourite free software so you won't have to spend a penny.

WEB BROWSERS

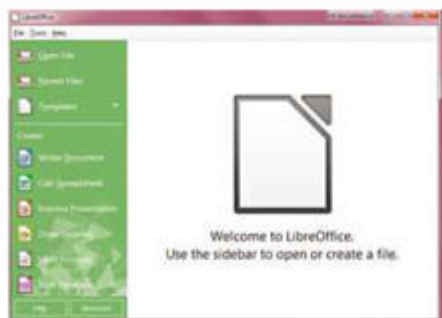
The first program you'll want on your new computer is a web browser to replace Internet Explorer. Ninite gives you the choice of Google Chrome, Opera and Mozilla Firefox. Chrome has its quirks but its integration with Google's products and services makes it difficult to resist. Mozilla Firefox has improved a lot in recent years and is very fast, and you get peace of mind that this not-for-profit foundation isn't trying to sell you anything.

DOCUMENTS

LibreOffice is an easy-to-use, open-source productivity suite. If you're not an advanced office software user, you'll find all the features you could want from its Writer, Calc, Impress, Draw, Math and Base applications. Even better, it supports the latest Microsoft Office formats so you won't have to convert your Microsoft files to open them.

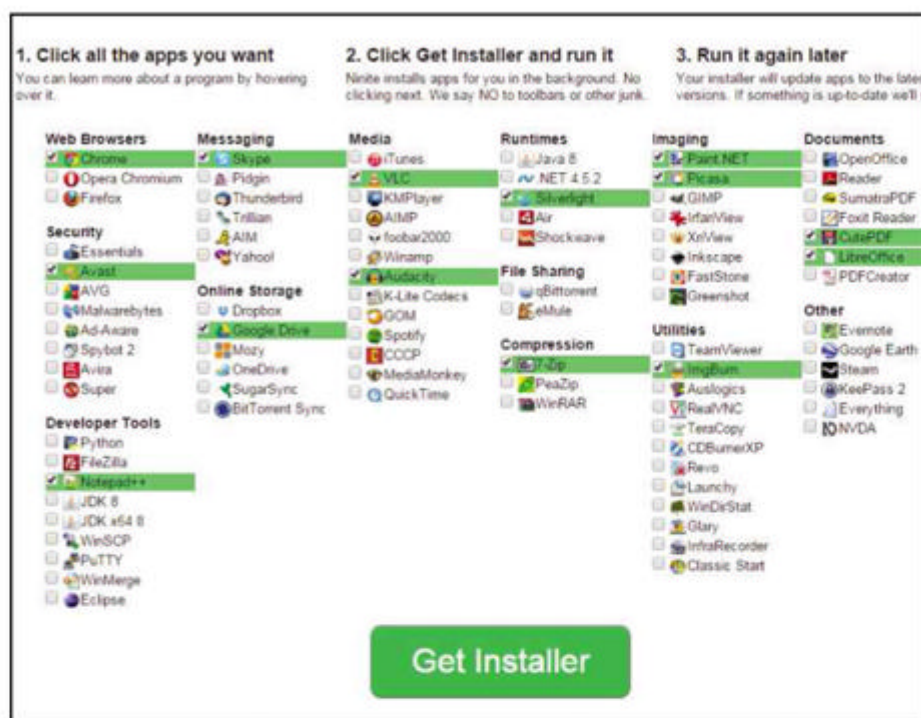
If you want to take quick notes or dabble in a bit of programming, Notepad++ is a sound addition to your list of Ninite downloads. It supports programming languages from C to HTML and pretty much everything in between, and you can easily test your creations by launching them straight from Notepad++ in a couple of clicks.

Adobe Reader has improved enormously in recent years and is now the best way to open, fill in and digitally sign PDF files without the need to print them. The only essential feature it lacks is a tool for converting documents to PDF, but this isn't a huge problem because you can also install CutePDF, which sets itself up as a printer on your system. You can then "print to PDF", turning any of your documents into PDF files in a couple of clicks.



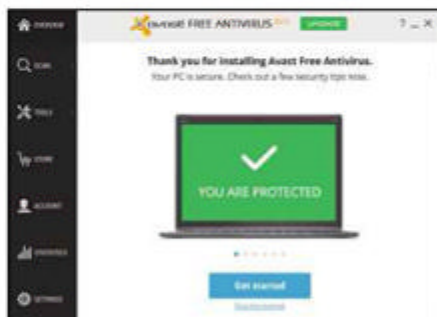
SECURITY

Avast Anti Virus has long been our favourite free security suite, thanks to its simple design, unintrusive behaviour and small system footprint. Even better, it stands up against the best of the premium anti-virus suites in our



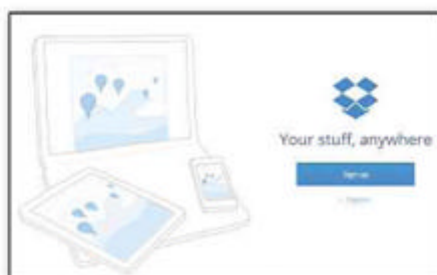
↑ Ninite has more than 80 free Windows applications to choose from and installing them couldn't be simpler

quarterly security tests, making it the perfect way to secure your system on the cheap. Ninite doesn't support paid-for security apps, but if you want to find out which security suites are the best, refer to our exhaustive test of internet security software (see *Group Test*, *Shopper 324*).



CLOUD STORAGE

You get a choice of six Cloud storage services on Ninite. Google Drive and OneDrive came out on top in our most recent Cloud storage group test (*Shopper 319*) thanks to generous free storage options and their ease of use.

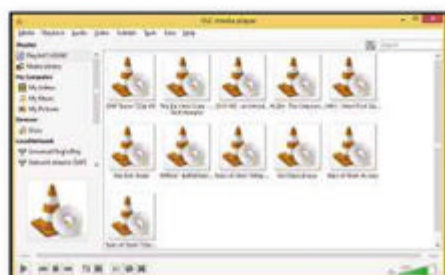


We've hand-picked
our favourite free software
so you won't have to
spend a penny

You should also consider SugarSync, which is a paid-for service that costs from £7 a month and lets you keep multiple folders across all your PCs in sync. Of course, there's also the most popular service, Dropbox.

PHOTOS AND MULTIMEDIA

If you have an extensive collection of video files in all sorts of wacky formats, VLC is the one piece of software you need. It has built-in codecs for many of the video files Windows Media Player can't handle, making it a must-have. To ensure you can play any file in any other application, we recommend downloading the K-Lite Codecs.



Business Help

If you have database, office application or macro issues, **Kay Ewbank** can help. Send your problems to businesshelp@computershopper.co.uk



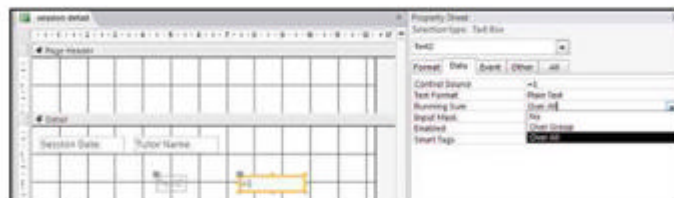
Serial numbers in Access

Q I have an Access report where I assign numbers to forms for our sports club members. I have each member's name and club number, but I want to have a serial number for each person that's separate from their club member number. I want to start the numbers at 100, ideally, but if necessary I can start from 1.

Owain Davies

A Starting from 1 is fairly easy. All you need to do is to add an unbound text box to the report, and set its Control source to =1. You do this in its properties. Next, set its Running Sum property to Over All. Unfortunately, this only works to create an incremental value if you start from 1.

If you want to have a serial number that starts from a larger number and goes up by one each record, what you'll need to do is have a second unbound text box that refers to the first text box; so



Use a Running Sum in an unbound text box to create serial numbers in Access

you could, for example, have the control source for the second text box as =textbox1 + 99. You then set the Visible property for the first textbox to No, so it doesn't show up.

This technique is also useful if you want to show ranking for records, though it doesn't deal with joint positions where two people have tied for the same place.

Revealing Excel columns in PowerPoint

Q I'm displaying Excel data in a PowerPoint presentation, and would like to animate it so the different columns of data appear one at a time when I click within PowerPoint. At the moment the entire spreadsheet object appears at once. This means the audience can see the final column, which contains the overall totals, so they tend to look at that rather than the earlier columns. I need to get them to look at one column at a

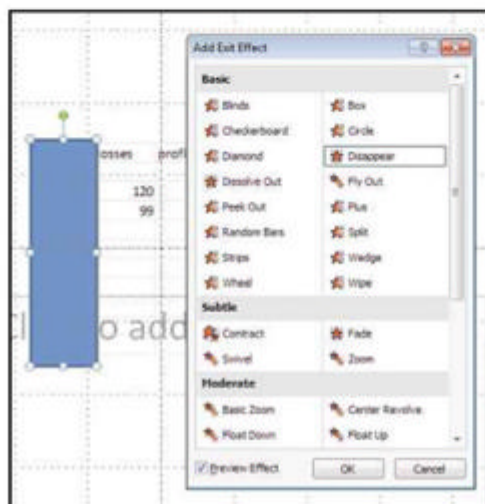
time while I tell them (and they join in the discussion) of the point I'm making about that particular element. How can I do this?

Oliver Charlton

A You can't animate an object, such as an Excel object, as it's one 'thing' as far as PowerPoint is concerned. We have two suggestions of how to achieve the effect you want. First, you could have different Excel objects on different slides, so you show slide 10 (say) with one column, then slide 11 with two columns, and so on until all the data is visible on the last slide of the sequence.

If you don't like that, you could have multiple PowerPoint shapes, each covering a column, overlapping with different columns. You could then use a disappear animation so when you click, the next shape disappears and your Excel object appears to get bigger. You can do this from the Animations tab of the Office ribbon, by choosing Animation Effects, Disappear.

Use a Disappear animation to reveal part of an Excel object in PowerPoint

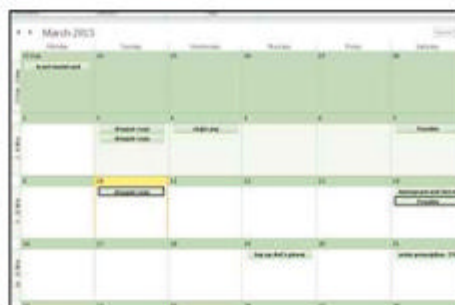


Copy Outlook appointments

Q I use the Outlook calendar for managing all of my appointments. I quite regularly need to repeat meetings from day to day. Is there a way in Outlook to copy an appointment from one day to another?

Julian Kent

A Yes, all you have to do is click on the appointment in the calendar. Press and hold down the Control key, then drag the appointment to the new date and time. This creates a copy at the new time, and leaves the old appointment intact. If you just click and drag the appointment without holding down the Control key, you move the appointment rather than copying it.



Copy appointments in Outlook using Ctrl and drag

Word references have strange formatting

Q I use Word to create books on a specialist subject. As new pages are added as I go along, I use the Word cross-reference facility to make sure that all references point to the right place. Typically, I refer to an item in three parts: Chapter, Position and Example. Each of these is a heading level in the styles. I want the results to look like this: Chapter 6 Position 4 Example 3; however, Word adds (or sometimes removes) spaces after Chapter and Position so the result isn't nicely formatted.

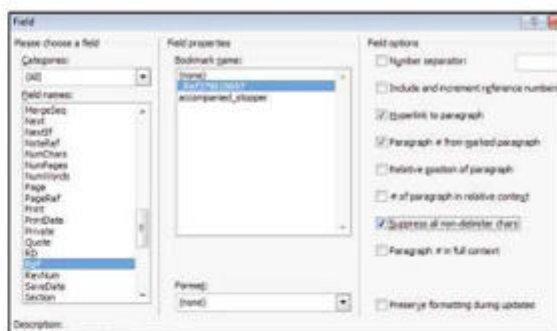
Try as I may, I can't fix this. It has persisted for years. I now use Word 2010 but the document is in Compatibility Mode.

Anthony Moon

A Our first observation is that by the time you get to a layout as complex as that of a book with chapters, figures and multiple tables, you'd probably be better off using a desktop-publishing program, such as Microsoft Publisher or Serif PagePlus. Word may have features that you can use such as chapters and content pages, but we'd be very worried about putting in a book's worth of work and trusting it to Word.

That word of caution apart, Word can be strange in the way it treats reference fields (those created using Insert, Quick Part, Field, then the REF field type). It's particularly tricky to say what will happen when you use a REF field that consists of a numeric element (such as a chapter number) and some static text.

This situation is made even more complicated by the fact that some entries are specified as a hyperlink to a specific paragraph within a chapter, while others link separately to the chapter and the paragraph. This was a major reason for the



↑ Set REF fields in Word to suppress non-delimiter characters to avoid layout problems

differing layouts, as Word always leaves at least one space between REF fields.

There are four possible options that could help. First, you could alter all the references to the same format – either separate Chapter and Position references, or combined Chapter and Position references.

A more useful option is to suppress non-delimiter characters. To do this, right-click the field in Word, and choose Edit Field. In the dialog that appears, put a tick next to 'Suppress all non-delimiter characters'. This gets rid of the text part of the reference, so a reference that points to Chapter 15 would no longer show as Chapter 15, but as 15. Similarly, Position 8 would just say 8 rather than Position 8. You can then enter the text portions manually, along with tabs and spaces, to get a more controllable layout.

An alternative suggestion, as the main problem for the layout is the extra spaces causing some of the text to wrap to the next line, is to widen the left-hand column of the table by a small amount so everything fits. This is low-tech, but might be the least amount of work. Similarly, you could make the Chapter and Position fields have condensed spacing by selecting the fields, then choosing Font, spacing, condensed.

Hiding zero values in Excel charts

Q I have some data in Excel that I display in a pie chart. Sometimes some of the values are zero, which makes the chart look silly. Is there a way to tell Excel not to print the segments that relate to the zero values?

Harry Anderson

A There are a number of ways to achieve this. First, you can alter the underlying data set so that cells that would be zero are converted to something else that won't display, such as NA. For example, if you're currently displaying the data from column B, then you could change the chart to refer to column C instead, and have a set of formulae in column C along the lines of: =IF(B2=0,NA(),B2).

What this says is that if cell B2 contains 0, cell C2 (the one being used in the pie chart) should contain NA (for 'not available'); otherwise cell C2 should contain the value from cell B2. This would be used all the way through the chart values.

As an alternative, you can format the cells so zeros are hidden, using a custom number format. Select the range of cells where you have the values for your chart, then right-click and, from the pop-up menu that appears, choose Format Cells. On the Number tab choose Custom from among the categories. You'll see a box labelled 'Type', with the current format displayed for the range you selected. Change the characters in the box to read #;;

Zero values (and any negative values) will now be hidden on the workbook and won't appear in your chart. We have a warning here: doing this is very confusing for other people looking at the data, or for yourself in six months' time when you've forgotten your clever trick, so put a note next to the data on the worksheet so you have a chance of working out what's going on! ☹

Convert Open Office to Excel

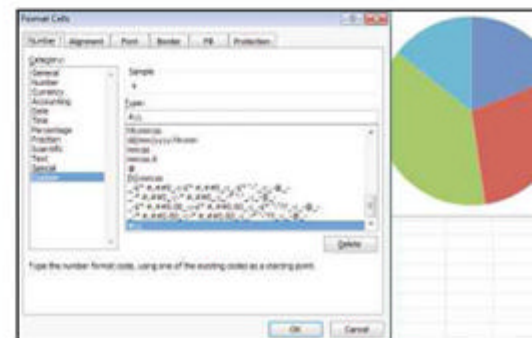
Q Please can you name a reliable piece of software that I can download to convert Open Office (.ods) spreadsheets into Excel (.xls or maybe .xlsx) documents? I have 30 or so simple .ods spreadsheets, which mainly contain values, but a few have formula and 'If' statements. I am quite happy to convert one file at a time; in fact I don't really trust any other method.

At the moment, when I open the .ods files using Office 2007 and Windows 7, the values are all present, but the formulae have been erased.

Geoffrey Paul

A You are correct in saying that Excel imports .ods spreadsheets without the formulae that were in the original Open Office format. While some programs say they can carry out the conversion, the simplest (and safest) technique is to install Open Office itself and use that. It has an option to let you save spreadsheets in Excel format, so achieving the result you want.

In Open Office Calc, choose File, Save As. Click on the Save as type drop-down box, and select the appropriate Microsoft Excel version. Click Save and the Open Office spreadsheet will be converted to Excel.



↑ Use a custom number type to avoid seeing zero values in Excel pie charts

Helpfile

Whatever your general PC, hardware and software woes, **Simon Handby** is here to help. Send your problems to help@computershopper.co.uk



With DHCP servers, two is too many

Q I have two PCs and a Western Digital WD TV Live HD media player, all cabled to a Netgear DG834 router, which doesn't have Wi-Fi capability. I also have an HTC smartphone that connects to my PC with a USB cable for synchronisation, charging and so on. This was also how I connected my phone to the internet for updating apps, until a friend gave me a Senao wireless bridge, which is now plugged into the router's fourth Ethernet port.

When the bridge is switched off, the two PCs have internet access and the WD TV can stream movies without issue from my main PC. When I switch on the bridge, the PCs retain their internet access, the phone can access the network and the internet, but the WD TV is unable to see my movies. If I examine its network settings, it reports: "IP address is correct. Incorrect DNS Server address." Everything works again once I switch the wireless bridge off, but of course I now have to connect my phone via USB.

It seems that something in the Senao wireless bridge is creating a conflict on the network, but I can't understand what's happening. I've tried to access the Senao's web administration interface from my phone, but although I did receive a login prompt this eventually just timed out, after which I was unable to refresh the page and couldn't even try to log in.

Mike Kingsley

A It seems likely that both the Netgear DG834 and Senao wireless bridge have DHCP (dynamic host configuration protocol) servers enabled, and that this is causing conflicts when both are switched on. Our first recommendation, given that the phone is able to access the internet through the Senao wireless bridge, was to use it to access the bridge's configuration menu. From your description,



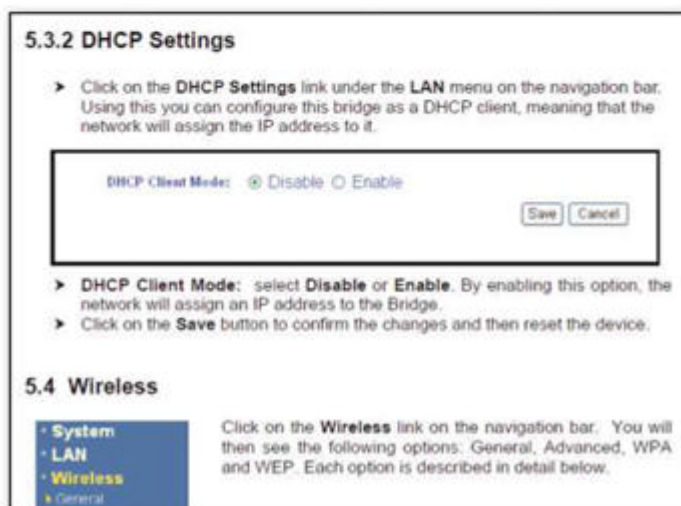
It's hard to access a router's configuration menu if there's a DHCP conflict – you often need to unplug the conflicting device first

however, it sounds as if there's only a short window before the conflicts on the network prevent the phone from exchanging data properly.

With this in mind, disconnect one of your PCs from the router and instead connect it directly to the Senao's Ethernet port. Reboot the PC, at which point it should lease an IP address from the Senao's DHCP server. You should now be able to connect to the Senao's administration interface at either 192.168.1.1 or 192.168.1.2 – we expect it should be the latter, which is used when the bridge is configured for Access Point mode. You should receive a prompt to log in; leave the user and password fields blank and click OK.

Once you're in the Senao configuration menu, click LAN in the left-hand bar, click DHCP under it, then on the DHCP settings page click Enable next to DHCP Client Mode, and click Disable next to DHCP Server Mode. Click Save, reboot the device when prompted, then restore the wiring to how it was. You may need to reboot your PCs and other devices, after which you should find that everything now works properly when the wireless bridge is turned on.

If you still can't connect to the Senao's web interface, its settings may have been changed from their default. You don't mention which operating system your PCs are running (it's not relevant to the problem); if it's Windows XP, click the Start menu, click Run, type cmd and click OK. If it's Windows Vista or later, open the Start menu or Start page and search for CMD, then run Command Prompt (or cmd.exe) in the results. In the command prompt window, type ipconfig and hit Enter, then scroll through the information to find 'Ethernet adapter Local Area Connection' (Windows XP, Vista or 7) or 'Ethernet adaptor Ethernet' (Windows 8). Look for Default Gateway under this heading, and make a note of the IP address. Now leave the connections as they are and try logging in to the Senao's web interface using the default gateway IP address you noted down. If this works, disable the DHCP server as described above before restoring the wiring and testing.



You may need to enable DHCP Client Mode in the DHCP Settings section of the Senao configuration menu

One headset to rule them all

Q I want to buy a single headset that can be used on all my devices. Isn't it about time that manufacturers produced a common system? Instead, all my equipment has differing connectivity:

- My laptop has no Bluetooth, but has USB and a single 3.5mm audio port
- My desktop PC has Bluetooth 4.0, USB, and 3.5mm headphone and mic ports
- My tablet has Bluetooth 4.0, USB and a single 3.5mm port
- My phone has a single 3.5mm port
- MP3 Player has a single 3.5mm port
- My TV has USB

I often travel in aircraft, too, so I appreciate that I may need to buy one or more adaptors.

↓ The humble 3.5mm audio jack may be old, but it's widely compatible



I haven't been able to get good advice on the high street, and retailers don't seem to stock what I might need. Ideally I'd like a quality over-ear headset with microphone, preferably with noise cancelling, for a budget of up to £300 including adaptors. Can you help?

Peter White

A Given that not all your target devices have Bluetooth or USB, we can rule out those interfaces and look for a headset using a conventional 3.5mm jack. There isn't an exact fit for your requirements in the Sennheiser range, but if you can live without noise cancelling, the HD 429s is an over-ear headset compatible with most smartphones and tablets. You'll need both an aeroplane adaptor and a four-pin 3.5mm to 2x three-pin 3.5mm adaptor; you can get both from Amazon for less than £10.

We found two other headsets that are a better match, both of which should be compatible with most devices. A budget option is Sony's MDR-ZX110NA, a noise-cancelling, over-ear headset. This comes with an aeroplane adaptor, but you'll still need to

➔ Bluetooth headsets may be the future, but they're not universally compatible



buy a four- to three-pole adaptor for your desktop PC. Nearer the top of your budget, Bose's QuietComfort 25 noise-cancelling headphones have a microphone and come with an aeroplane adaptor, but again you'd need the four- to three-pole adaptor. We haven't reviewed these headsets, so we can't make a specific recommendation, but we note that Bose offers a 30-day 'risk-free' trial.

A headset's four-pole audio jack should work fine with the standard three-pole jack in your MP3 player, but if not you can use the headphone port on the four- to three-pole adaptor. Similarly, most TVs should have a standard 3.5mm headphone socket; we'd be surprised if yours doesn't.

Slow copying between my disks

Q I have a Windows 7 computer with two internal 2TB hard disks. One contains the operating system on a C: partition, and a D: partition with data recovery. The other disk has a single partition (E:) and contains my data.

Recently, when transferring large amounts of data to the E: drive, whether from the other disk or from an external drive, the computer slows to a crawl. As an example, when trying to back up the C: drive to the E: drive using Acronis True Image, the transfer rate slows to less than 1MB per second. Transferring files from the E: drive, on the other hand, is as fast as it ever has been.

In all other respects the computer appears to be running normally. I use Norton Internet Security, and I have the free version of Malwarebytes Anti-Malware, neither of which reports any issues. I wonder if one of these could be causing the problem, but I'm

not sure why it would have started happening now. I haven't installed any new software that would explain the change in behaviour. I've noticed that the slowdown also happens if I try to check disk E: for errors from within Windows. Please could you suggest a cause and a possible solution?

Keith Jones, senoj07-disp@yahoo.co.uk

A It's not immediately obvious what the problem is, but there are several possibilities. Whether or not the disks are identical and connected to the same disk controller, we'd expect them to perform in largely the same way. We also wouldn't expect such a large discrepancy in the read and write speeds of one disk: either some software is interfering, or there's a configuration issue or hardware fault.

It's unlikely that any anti-malware program would be responsible for such a severe slowdown in file copying, particularly given that it only happens in one direction to one of your drives. The free edition of Malwarebytes Anti-Malware doesn't include real-time scanning, so you can almost certainly rule that out.

We'd suggest checking the disk for errors from a command prompt: open the Start menu and type cmd, then right-click cmd.exe in the search results, select Run as administrator, and provide permission if prompted. At the command prompt, type wmic and hit Enter, then type 'diskdrive get status' and you should see 'OK' twice (once for each disk). If so, type exit and hit Enter, then type 'chkdsk e: /f' (without the quotes) and hit Enter again. If you're prompted to force a dismount on the disk, reply N and hit Enter, then reply Y and hit Enter when asked if you want to schedule a disk check the next time the system is restarted. With this done, save your work and reboot the computer, then allow the disk check to complete.

It's usually hard to tell if the disk check found anything before the screen is cleared, but when the computer has rebooted, open the Start menu, type event and run Event Viewer in the results. In the left-hand pane, expand Windows Logs, right-click Application, select Find... and search for chkdsk. This should highlight the log file for the chkdsk process; double-click the entry and read through the information in the text box to see if any problems were found and fixed.

If you didn't see two 'OK's earlier, or problems were found in the disk check that couldn't be fixed – particularly bad sectors – the disk is probably failing. Back up the contents if you haven't done so already, and contact the manufacturer. 📺

```
C:\Windows\system32>wmic
wmic:root\cli>diskdrive get status
Status
OK
OK
OK
OK

wmic:root\cli>exit
C:\Windows\system32>chkdsk e: /f
```

↑ Use the Windows Management Instrumentation Command Line to quickly check the SMART status of your disks

Make a home monitoring system

PART
1

In the first of a two-part guide, **Clive Webster** shows you how to set up an inexpensive home surveillance system to keep an eye on things



IP CAMERAS ARE a great way to keep an eye on your valuables while you're out, or to see which of your cats is destroying your sofa from the comfort of the office.

While a £60 D-Link DCS-942L camera, such as the one we used for this feature, can connect wirelessly to your home network or D-Link's cloud service, what if you want a bit more control? Perhaps you want to leave a camera recording for longer than the week's video you can fit on a microSD card? Or maybe you just feel more comfortable storing sensitive video on your own machine rather than on a third-party cloud server, at possible risk from hackers?

All this is possible using an old PC, a free copy of Ubuntu Server and the open-source ZoneMinder CCTV software. In this month's *Advanced Projects*, we'll get you started on setting up your system. You'll need a PC that you no longer need, as we'll wipe its hard disk during setup.

INSTALLATION

Although the instructions on ZoneMinder's wiki seem to suggest that the software works best with Gentoo Linux, this distribution can



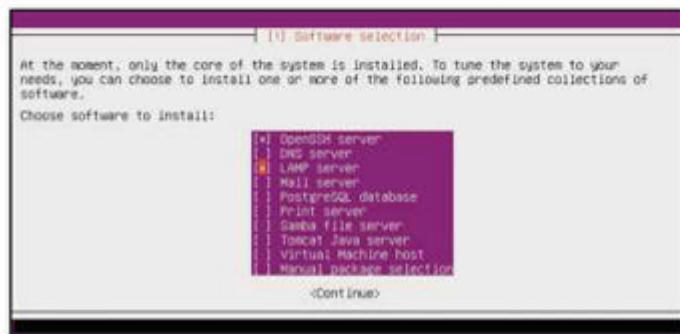
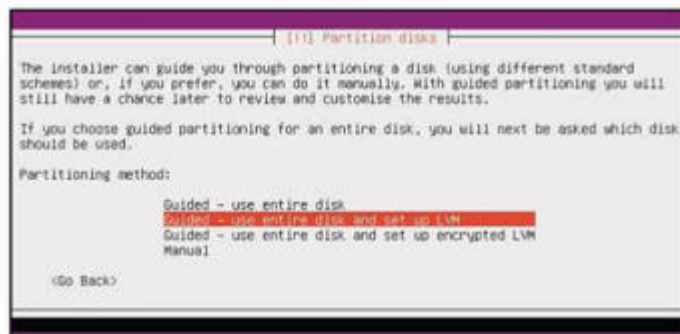
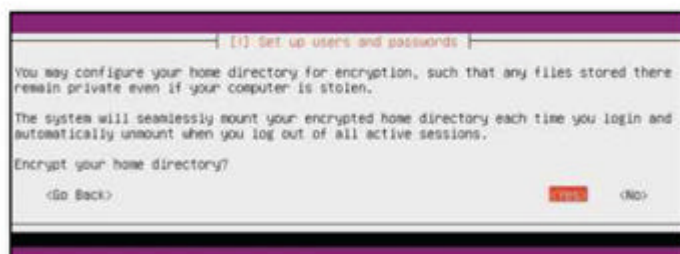
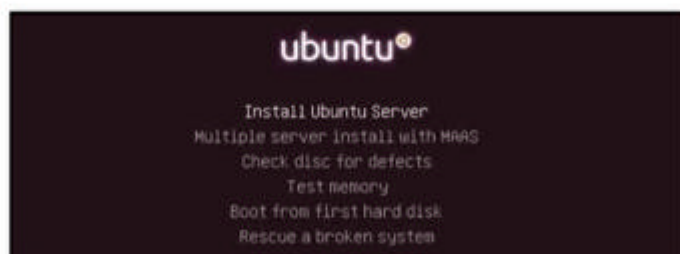
▲ D-Link's £60 DCS-942L (left) has infrared night vision and Wi-Fi and is small enough to place anywhere. The DCS-6010L (right) is a 2-megapixel, ceiling-mounted camera with Wi-Fi and a fisheye lens

be tricky to set up. We therefore opted for the friendlier and more flexible Ubuntu Server 14.04 LTS, from www.ubuntu.com/download. If you're using a very old PC or laptop, it might not have a 64-bit processor, so you'll have to download a 32-bit version of Ubuntu Server from www.ubuntu.com/download/alternative-downloads. If you're not sure whether the PC

you want to use for ZoneMinder is 64-bit or not, download and run CPU-Z from www.cpuid.com, and look for something like 'x86-64' in the Instructions section. Once Ubuntu Server has downloaded, burn the .ISO file to a DVD, or use USBWriter, from tinyurl.com/usbwriteriso, to create a bootable USB flash drive.

Power up your PC and enter its BIOS, usually by repeatedly pressing the Delete key on a desktop machine, or F2 on a laptop, just after you power it on. As well as changing the DVD drive or USB flash drive to be the primary boot device, you might want to hunt around the BIOS for other useful options for a server. For example,

most desktop BIOSes have an option to turn the PC back on automatically after losing power. You should also check that the system will 'Halt on No Errors' so that it will boot even without a keyboard. Connect your server machine to the internet via Ethernet, insert your installation DVD or flash drive, save your BIOS changes and exit.



▲ Installing Ubuntu Server is fairly straightforward, and there's a good guide online, but these four options might trip you up. Follow the options highlighted in the screenshots and you should be fine


```

GNU nano 2.2.6      File: /etc/init.d/zoneminder

### END INIT INFO
# description: Control ZoneMinder as a Service
# chkconfig: 2345 20 20

# Source function library.
#. /etc/rc.d/init.d/functions

prog=ZoneMinder
ZM_PATH_BIN="/usr/bin"
command="$ZM_PATH_BIN/zmpkg.pl"

start() {
    sleep 15
    echo -n "Starting $prog: "
    zmfix -a
    $command start
    RETVAL=$?
    [ $RETVAL = 0 ] && echo success
    [ $RETVAL != 0 ] && echo failure
}

Cancelled
Get Help  WriteOut  Read File  Prev Page  Cut Text  Cur Pos
Exit      Justify   Where Is   Next Page  UnCut Text To Spell

```

⬆ Delay ZoneMinder's startup to allow MySQL to load first

Ubuntu Server's installation process is fairly straightforward; most of the options are explained clearly, and the default settings are typically fine for our uses. We recommend selecting the options to wipe the hard disk of the server machine (copy valuable files from the server machine before formatting) and to install security updates automatically.

When asked what additional software to install, use the up and down arrows to highlight OpenSSH and LAMP Server and select these services using the space bar. Pressing Enter will start a lengthy install process, so only press Enter once you've highlighted the extra services you require.

As Ubuntu Server is a general-purpose server operating system, you might want to add other services such as an email or a print server at this point. The LAMP Server service is a bundle that will install Apache2, PHP and MySQL Server. The last service requires its own password – choose one that's strong, unique and memorable.

While Ubuntu Server installs, log into your router and assign the server machine a static IP; refer to your router's manual to find out how. We think the Ubuntu Server installer is a little premature in its prompt to remove the installation media, so wait for your system to reboot automatically, then re-enter the BIOS to make your primary hard disk the primary boot device, then remove your installation media and save and exit the BIOS. Once your system has rebooted, you should see a typical

Linux boot-up screen: a string of text declaring that certain services have loaded. Log in using your user (not MySQL) credentials and begin to install ZoneMinder.

INSTALLING ZONEMINDER

To make the following steps easier, become a super user by typing 'sudo su' and then entering your user password. The commands below will update Ubuntu Server, your applications and your distribution before installing ZoneMinder.

```

apt-get update
apt-get upgrade
apt-get dist-upgrade
apt-get install zoneminder

```

These are commands typed into the Console, so hit Enter after each. You might be asked to confirm some of these updates and installations; type Y and hit Enter when asked. Next, you need to delay ZoneMinder's initialisation so MySQL can fully start before it. Type 'nano /etc/init.d/zoneminder' (without the quotes) and hit Enter. Scroll down this configuration file to find the line 'start() {' and add the following underneath:

```

sleep 15
echo -n "Starting $prog: "

```

Press Ctrl-X, Y and then Enter to save and exit the configuration file.

Next we need to do a few fiddly changes to integrate ZoneMinder with the Apache2 web server application so that we can access ZoneMinder via a web page. First we need to create a new directory, then two symbolic links (shortcuts), then we need to activate the Common Gateway Interface (CGI), which is an interface between a web server and web client. After that, it's time to create a new user and then restart Apache2 with these new settings. That's a lot of fiddling, but don't worry about the details; just type these commands into the Console, followed by Enter:

```

mkdir /etc/apache2/conf.d
ln -s /etc/zm/apache.conf /etc/
apache2/conf.d/zoneminder.conf
ln -s /etc/zm/apache.conf /etc/
apache2/conf-enabled/zoneminder.conf
a2enmod cgi
adduser www-data video
service apache2 restart

```

You may see an error when restarting Apache2 saying it can't reliably resolve the localhost name. Unless you're adding other services to your server, you can ignore this.

VERSION CHECK

ZoneMinder's wiki was helpful when we wrote this article, using Ubuntu Server 14.04 and ZoneMinder 1.26.5; if either piece of software has been updated significantly by the time you read this, check tinyurl.com/zm-on-us for up-to-date installation instructions.

The next stage is to install Cambozola, an application that allows you to view JPEG-based video streams. Download the latest version as a compressed tarball, then extract the application and copy it to ZoneMinder's directory with the following commands:

```

cd /usr/src && wget http://www.
andywilcock.com/code/cambozola/
cambozola-latest.tar.gz
tar -xzf cambozola-latest.tar.gz
cp cambozola-0.935/dist/cambozola.jar
/usr/share/zoneminder

```

The '0.935' part of the last command refers to the version of Cambozola being used. As the first command downloads the latest version, this may change. Check your screen and you'll see the version number displayed clearly in many of the installation messages, so change the '0.935' to whatever version of Cambozola it is you've downloaded.

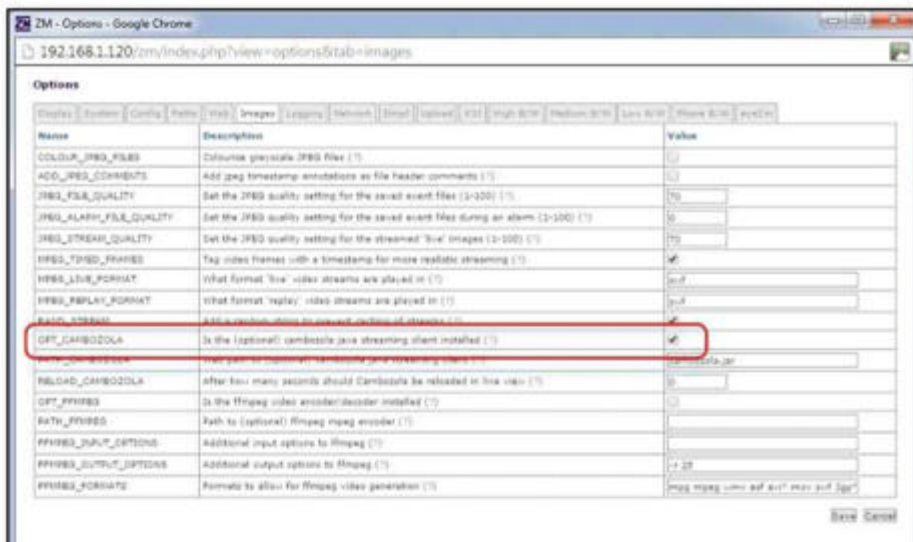
The final piece of setup is to force the server to synchronise its time and date with a Network Time Protocol (NTP) server. Create and edit a new file by typing 'nano /etc/cron.daily/ntpdate' (without the quotes) and hitting Enter. Add the header and the single line of code below before saving and exiting by pressing Ctrl-X, Y and Enter.

```

GNU nano 2.2.6      File: /etc/cron.daily/ntpdate      Modified
#!/bin/sh
ntpdate ntp.ubuntu.com

```

⬆ Force your server to maintain an accurate time and date with Network Time Protocol



⬆ Before you start adding cameras to ZoneMinder, you'll have to change some things in the Options menu

```
#!/bin/sh
ntpdate ntp.ubuntu.com
```

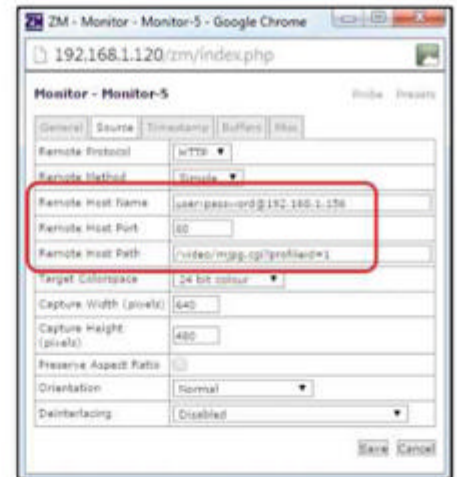
Make this file executable by typing 'chmod 755 /etc/cron.daily/ntpdate' (without the quotes) and hitting Enter. You should now be able to log into ZoneMinder from a different device connected to your network by typing '<ServerIP>/zm' into a web browser, without the quotes and where <ServerIP> is the static IP address you assigned to your server machine. You will be greeted by the uninspiringly empty and dull ZoneMinder Console screen.

Go into ZoneMinder's options via the link toward the top-right of the Console and ensure that 'Check_for_updates' is unticked. Click Save and open the Images tab to make

sure that 'Opt_Cambosola' is ticked. Click Save and then close the window.

ADDING CAMERAS

Whatever make and model of camera you're using, your first job is to connect each one to your network. It's best to reset the cameras to their factory defaults, and then plug them into your router via Ethernet one by one. Log into your router, find the IP address of the camera, set your router to make that IP address static, type that IP address into your browser, log into the camera (you can find the default log-in details in the camera's manual, or at router-defaults.com) and change its access password. You might also want to give the camera a useful name, such as 'livingrm', or update the camera's firmware;

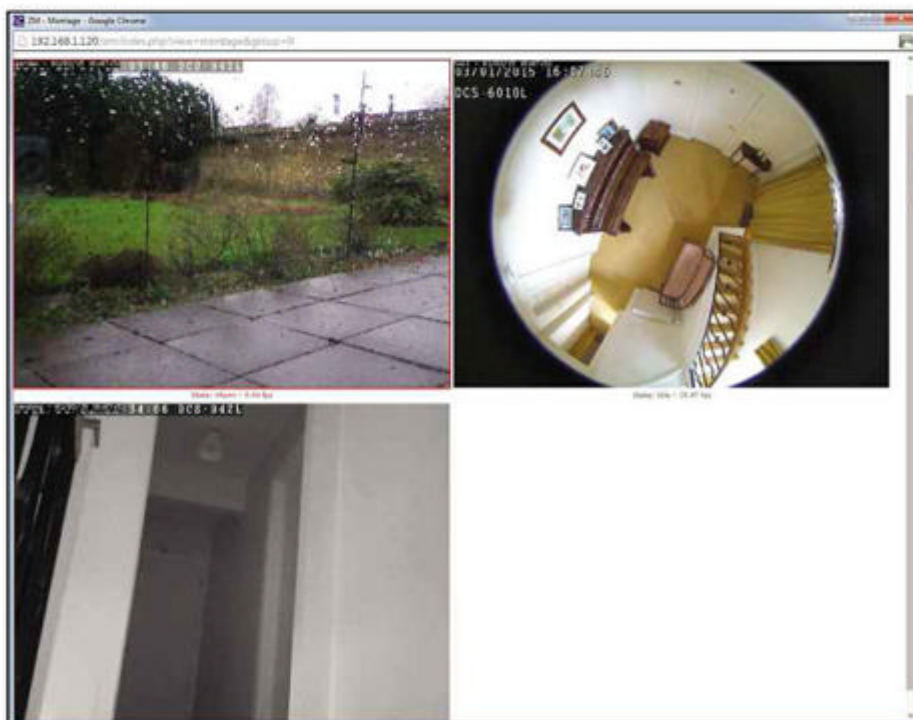


⬆ Each camera requires slightly different setup parameters. See ZoneMinder's supported hardware wiki for the specific details for your particular cameras at tinyurl.com/zm-cams-setup

refer to the camera's manual to discover how. Repeat this process with each camera.

Now that your cameras are connected to your local network you can connect them to ZoneMinder. Each camera requires slightly different details, but the process is the same. On the ZoneMinder Console click Add New Monitor and give the camera a useful name ('livingrm', for example), set its Source Type to Remote and its Function to Modect (short for 'motion detection'). Next, open the Source tab and enter a Remote Host Name, remote Host Port and Remote Host Path. You can find exactly what to enter in these fields by finding your camera's entry in the network cameras section of the supported hardware wiki at tinyurl.com/zm-cams-setup. We found it best to keep the video resolution at 640x480 pixels on the Source tab – ZoneMinder would only display a red box from our 2-megapixel D-Link DCS-6010L at other resolutions.

Once your cameras have all been added to ZoneMinder, they'll start recording video to the server machine when they sense motion. This works even if the cameras themselves don't support motion detection; the 'Modect' Function tells ZoneMinder to do the motion detection analysis itself. View the recordings by clicking on the numeral in the Event column for the camera in question; a new browser window will appear with a list of recordings. Use the tickboxes to select groups (for deletion, playback or export) or click the name of an event to view it. A new browser window will open, with playback buttons and other details. Back in the Console screen, the Montage and Cycle links can also be useful now that a few cameras have been linked to ZoneMinder. Montage opens a browser with all the video streams on display, while Cycle shows each video stream in sequence. 📺



⬆ See all your camera's video streams at once using the Montage feature

NEXT MONTH

REFINE ZONEMINDER AND ENABLE ALERTS

We put the finishing touches to our home surveillance system, and set up alerts to warn us when motion is detected

3D modelling with your tablet

Using your iPad or Android tablet to create people, creatures and other 3D models is surprisingly easy. **Ben Pitt** connects with his inner Michelangelo



COMPUTERS HAVE REVOLUTIONISED

almost every creative pursuit, from music to photography to literature. They have also spawned a completely new medium – computer-generated graphics – but this is an area that has proved stubbornly awkward for the average home user to get into. 3D modelling software has a reputation for being expensive and impenetrably complicated. It's a reputation that's often well deserved, but not in the case of 123D Sculpt+.

Available for free for iPad and Android tablets, 123D Sculpt+ (www.123dapp.com) is published by Autodesk – a major player in professional 3D graphics software with Maya and AutoCAD. Unlike those flagship programs, though, its 123D range of desktop and mobile apps are aimed squarely at hobbyists. 123D Sculpt+ specialises in character modelling.

It's a big download at 490MB and is processor-intensive too, so it might prove to be too much for less powerful hardware. We got on fine running Sculpt+ on a third-generation iPad, but it was a little unwieldy and unresponsive on a basic Lenovo Yoga Tablet 8 with a quad-core 1.2GHz processor.

Launch the app and you'll be presented with a showreel of other users' 3D creations. Click any of these to load them and take them for a spin in 3D space. It's a great way to see what's possible, but the real fun comes from making your own models.

While other 3D modelling software builds up structures from shapes, Sculpt+ is closer to working with virtual clay

Tap the Create button and you'll see three options: Build from Scratch, Ready to Sculpt/Paint and Ready to Pose. The last two options give you a head start if you just want a quick play with the software. For this tutorial we'll start from scratch to show the entire process.

BODY PARTS

Tap Build from Scratch and you'll get a choice of templates as your starting point, including humanoids, animals and spaceships. It's worth noting that Sculpt+ is better at building creatures than vehicles or anything

else with straight lines. While other 3D modelling software builds up structures from geometric shapes, Sculpt+ is much closer to working with virtual clay.

This first stage of model design is based on a skeleton structure. It's a bit like making

animals with modelling balloons. For our model we started with the Capsule, which is the simplest form with just two points.

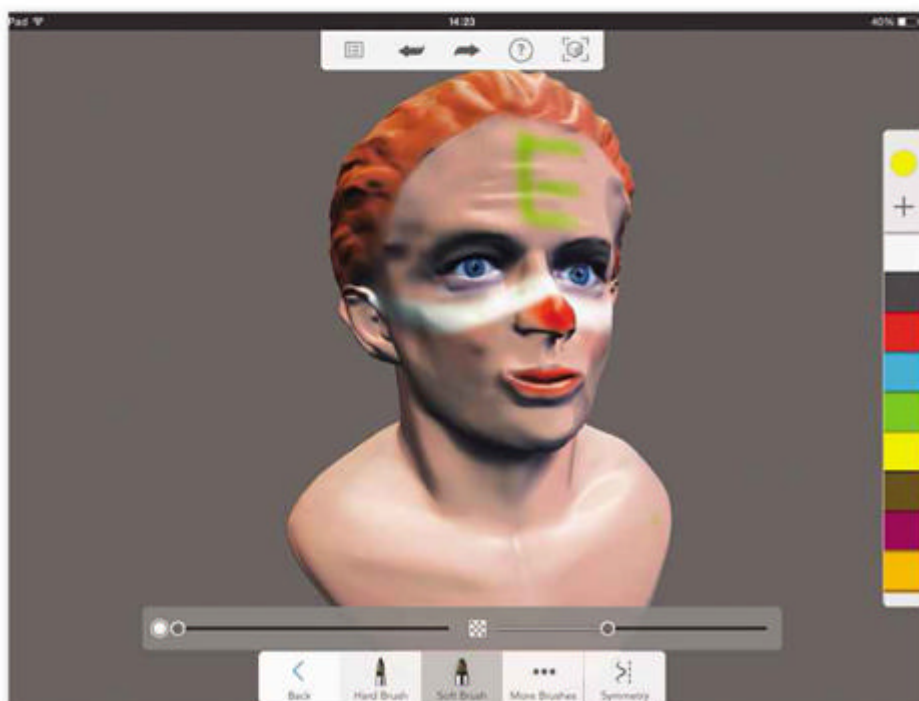
With the Create tool selected, dragging from an existing joint creates a new one extending from the first. Models at this stage are symmetrical, so new limbs that extend from the centre will be replicated on the other side. Tapping a joint gives options to delete it, or to cut, copy and paste. The latter three commands don't apply just to a single joint, but all interconnected ones downstream from the centre of the model – useful for copying legs, for example. To add a joint in the middle of a limb, just tap the limb twice.

Drag outside the model to rotate the camera around it, and drag with two fingers to pan and zoom the camera. If the camera spins out of control, tap the icon at the top that shows a box inside a square to reset the camera position. Switch to the Move tool and you can move existing joints and limbs.

One of the big challenges of 3D modelling is trying to manipulate an object in three dimensions using a two-dimensional interface. In other 3D software that often means using complex tools with separate handles for each dimension. In Sculpt+ it's much simpler. Objects are only ever moved up, down, left or right in relation to the current view. To move something nearer to or further away from the camera, simply rotate the camera so the required motion becomes left or right.

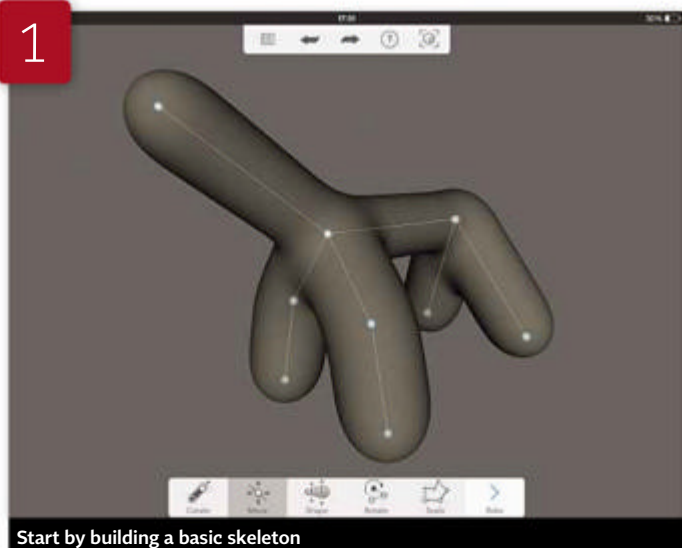
SHAPE OF THINGS TO COME

Once you've made something that vaguely resembles the thing you're trying to create, switch to the Shape tool. Two blue bars will appear on each limb, and dragging them up or down changes the bulk of the model around that limb. It's perfect for creating humans and



▲ 123D Sculpt+ is 3D modelling for everyone. This example was decorated with the help of our five-year-old

1



Start by building a basic skeleton

2



We've added extra limbs here to fill out the belly and chest

5

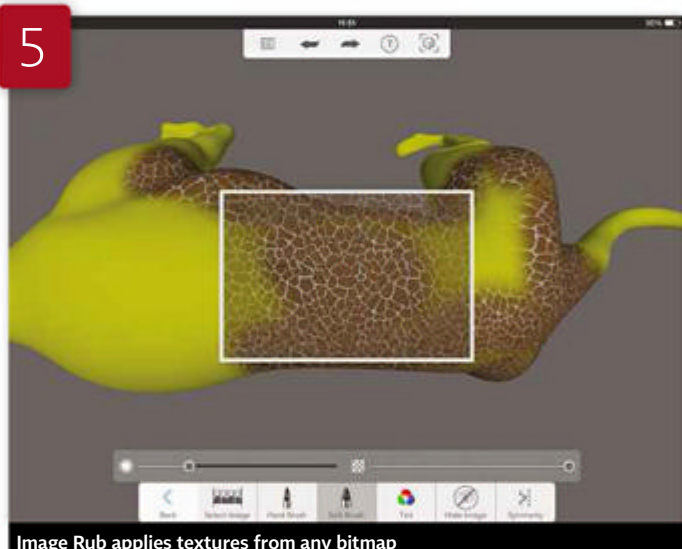
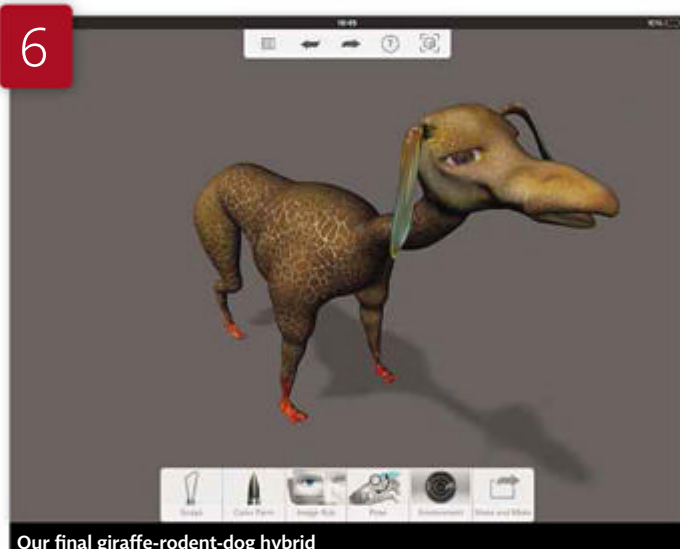


Image Rub applies textures from any bitmap

6



Our final giraffe-rodent-dog hybrid

other creatures as it creates an impression of muscle mass. Because each limb has two Shape controls, it's possible to taper them to produce organic-looking shapes.

For our creature, we added a few extra limbs to build up the chest, producing a complex shape that gave it a sense of having a rib cage and internal organs. We made it a bit easier for ourselves by creating a mythical beast, as it meant we didn't have to worry too much about accuracy. We still wanted to make our creature believable, though; giving it a sense of weight and mass with these Shape controls is a key part of achieving this.

The Rotate and Scale tools can help if your model is taking shape but you realise that the pose or scale of certain parts isn't quite right. Select the Rotate tool, tap on a joint and circles will appear for rotation in any axis; rotate the model to see all three axes. The Scale tool couldn't be simpler: drag a joint up to increase, or down to decrease, the size of the limbs that extend off that joint.

The Rotate tool is also useful for models where limbs fold over, such as arms that hang down the sides of a model. When designing the skeleton, Sculpt+ has a tendency to merge

nearby limbs into one, so you might end up with an area of conjoined flesh instead of an armpit. One way to avoid this is to create the skeleton with arms and legs outstretched. Later on you can adjust the pose after you've chiselled each element into shape.

A lot can be achieved in Skeleton mode, but the next stage is better suited to adding fine details. You can't go back and forth between the two modes, though. There's an option in the next stage to Extract Skeleton, but this loses all the sculpting and colouring work. Sculpting mode is great for refining shapes and adding intricate details, but not for adding significant extruding elements. The underlying wireframe mesh can only stretch so far before it becomes corrupted or annoyingly visible. The general rule is to get the overall structure right before moving on, but don't worry too much about fine details.

UNDER THE KNIFE

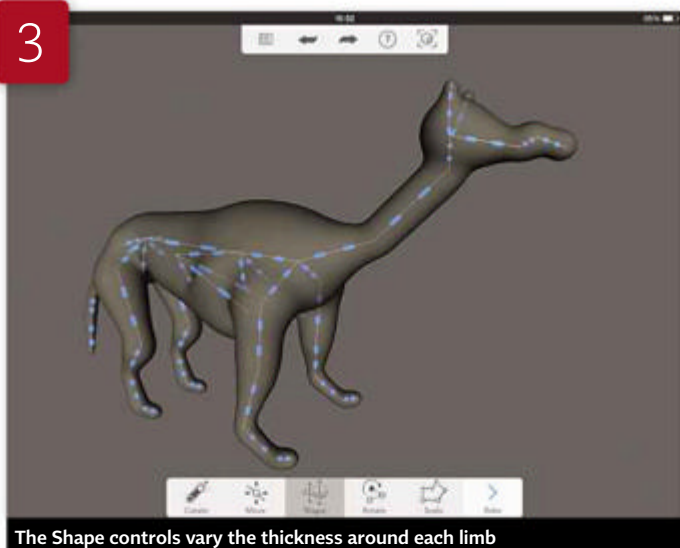
When you're happy with your skeleton, it's time to press Bake to prepare it for the digital scalpel. The skeleton model is converted into a wireframe mesh, and there's a completely different set of tools with which to modify it.

You can tackle the next tasks in any order, but we'll start with the Sculpt Tool. This is actually a suite of tools and their behaviour is fairly complex, so let's look at each one in turn. On the far right is a Symmetry button, which is on by default and keeps a line of symmetry in the model. It might be useful to turn this off at some point – a bit of asymmetry adds some character and prevents models looking overly computer-generated. However, once you turn it off and start editing the left and right sides independently, turning Symmetry back on can produce strange results. As such, it's best to do as much work as possible with Symmetry turned on, and only disable it for some final adjustments at the end.

The next tool to get to grips with is Grab. This picks up an area of the wireframe and drags it in the direction that you swipe your finger. As with the Skeleton tools, any adjustments are made in the plane that you can see – you can't drag nearer or further – so rotate the virtual camera to control which dimensions the model is moved in.

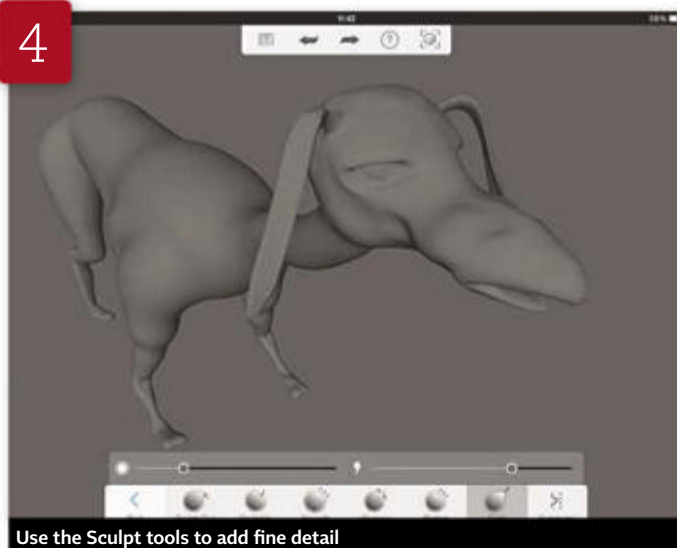
All the Sculpt tools have the same two sliders that control their behaviour. The left

3



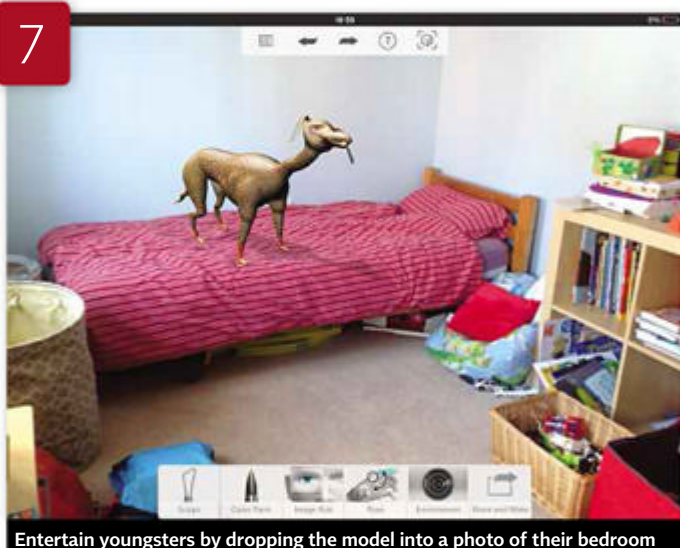
The Shape controls vary the thickness around each limb

4



Use the Sculpt tools to add fine detail

7



Entertain youngsters by dropping the model into a photo of their bedroom

We found that the best way to create intricate details such as facial features was to create oversized versions of them and then use the Grab tool to condense and refine their shape

one sets the radius of the tool, so a low value just picks up the area directly under your finger, whereas a high value applies broad gestures to a larger area. A blue sphere appears as you adjust the slider to show the effective radius. The right slider sets the strength of adjustments. Sometimes it's useful to make a dramatic change in one quick gesture, such as when moving a limb to a new position. At other times it's better to adjust using lots of subtle strokes, gradually moulding the virtual clay into position.

Sculpt Out adds extra bulk to the model. It doesn't matter which angle you view the model from, as the added elements are layered on top of what's already there. Sculpt Out can create a wide range of effects depending on the settings used. Medium Size and high Strength values produce distinct raised shapes that resemble sinuous muscles under the skin. Reduce the Strength and apply multiple strokes and you'll achieve a smoother effect that looks more like fat than muscle. A small Size and medium Strength creates the impression of raised veins or a hair texture. Building up repeated strokes creates details such as eyes, noses and mouths.

The Sculpt In tool is the reverse of Sculpt Out. It's great for reducing bulk, creating chiselled cheekbones and hollowing out armpits and backs of knees. It's also useful for facial features, but be warned that these are the hardest to get right. We found it impossible to create features with anything like the detail of the supplied templates. Using the Sculpt In tool to create nostrils or earlobes turned the underlying wireframe into a mess of spiky polygons.

FACIAL RECOGNITION

We found that the best way to create intricate details such as facial features was to create oversized versions of them and then use the Grab tool to condense and refine their shape. That way we could create complex folds that were smaller than the narrowest Sculpt In brush setting.

The Smooth tool is useful for evening out messy areas. It's particularly handy when the Sculpt In tool has resulted in some spiky polygons that need tidying up. Sharpen does the opposite, exaggerating details by bringing them to a crisp edge. This works well for eyelids and hair texture: create the basic

shape with the Sculpt Out tool set to a small brush size, then go over with the Sharpen tool to accentuate and clean up the details.

The last tool in this set is Flatten, which is similar to Smooth but more aggressive. We didn't find much use for it but you may have a different experience.

There are a few more tools available for shaping your model; tap Back followed by Pose to access them. The Pose tool lets you add joints by tapping anywhere on the model, and then dragging part of the model to reposition it. The glowing green area denotes the width of the joint. For a shoulder or elbow you may want to pivot around a relatively small area, whereas for a waist or neck you'll probably want a wider area so the rotation is more evenly spread out across the body. As we mentioned earlier, we found that it's useful to build the skeleton with arms outstretched, sculpt it into shape and then pose the arms as necessary at the end; this is the way to do it.

The other tool in this set is Orient, a single slider that adjusts which way is up. It doesn't make much difference in most respects, but it comes in useful when experimenting with light and shadows later on.

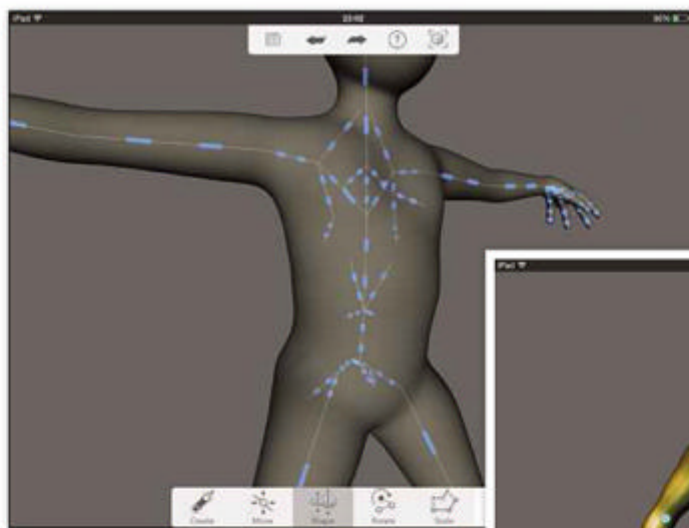
PAINT JOB

The Color Paint tools are relatively straightforward. Simply pick a colour, adjust the brush size and strength and start painting. There's a choice of hard and soft brush types, with the latter acting more like an airbrush with a soft edge to the painted area. Under More Brushes you'll find various other options that add textures to brush strokes.

The Image Rub option is a little more interesting. This tool turns any bitmap image into a virtual transfer that can be applied to the model. There's a selection of textures, faces, eyes and tattoos supplied, but it's also possible to import photos or capture them directly with your mobile device's camera.

Load up an image and it will appear in a box superimposed over the model. Drag outside the box to position the model so that the image lines up where you want it, and then drag across the image to apply it. Once again there's a choice of hard and soft brushes. Most of the time a soft brush works best, but a hard brush might be useful if you're adding an eye and don't want to go over the edge of the eyelid, for example.

We used this tool to add a giraffe texture to our model, using a soft brush so the various patches blended together. It's important to think about how much you zoom into the model when applying textures, as this sets the scale of the texture as it appears on the model.

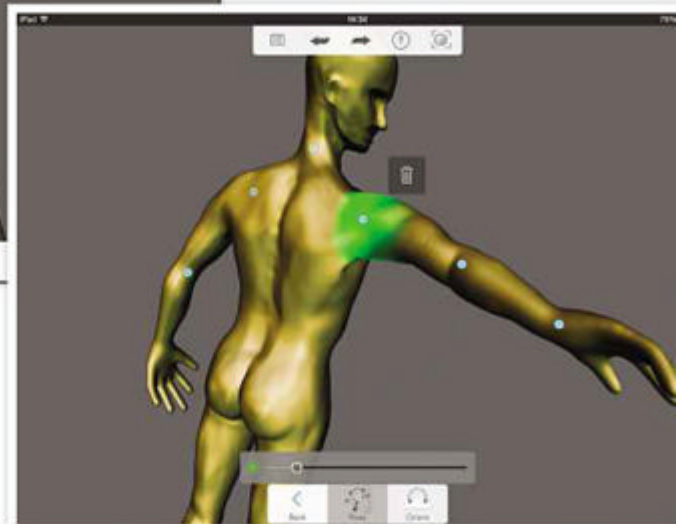


↑ It's worth stretching arms out when designing the skeleton as this makes them easier to work on later

FINISHING TOUCHES

The Environment tools let you decide how your model will be presented. Tap Lighting and choose from a variety of preset light effects. Tap the image to hide the preset buttons and you'll find a slider that adjusts the angle of the light. It's worth experimenting with Lighting in conjunction with the Materials settings. This defines how light reflects off the model, with 12 presets here including Clay, Pewter and Chrome.

The Background settings let you choose a background image. There are various images provided – most are simple gradients but there's a small selection of city and landscape locations too. There's fun to be had from importing your own photos, making your 3D models appear in holiday photographs or alongside the family pet. You may need to



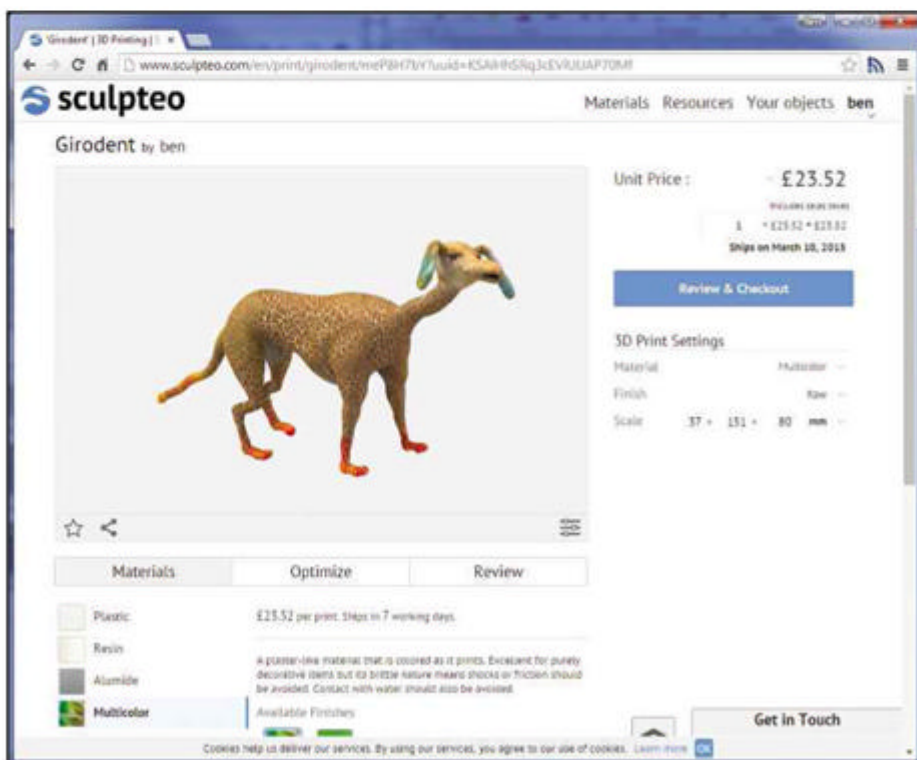
↑ Once you've finished sculpting you can reposition limbs and other elements using the Pose tool

revisit the Materials and Lighting settings to get the colours and light angle to match the photo as closely as possible.

The Effects settings comprise five simple photo filters that are applied to the entire image. They don't do much for us but they can be handy for helping the model and background blend together more convincingly.

The Share Image button lets you export as a bitmap to Facebook, Twitter or your device's local storage. That's not the only way to export models, though. Tap Back to return to the main toolbox and a Share and Make button will appear. There's an option here to Publish to the online community of Sculpt+ users. Export Mesh generates an OBJ file of the model, which is a standard 3D format that's supported by various other software. We successfully imported models into FXHome Hitfilm 3 Pro (see *Reviews*, *Shopper* 327), and are looking forward to exploring what we can do with the two applications.

Another option is to order a 3D print of your model. This is provided by a company called Sculpteo (www.sculpteo.com), with prices ranging from €6.60 to €9.16 (around £4.74 to £6.57, plus tax and shipping from France) for a single-colour 8cm high model. For more size, material and colour options, export as an OBJ file and upload the zipped file to the website. Prices rise dramatically as the size increases – a 30cm model came in at £167 – but it would make a novel present for the person who has everything. 📺



↑ You can order a 3D print of your model from the web

NEXT MONTH

IOS SYNTHESIS

Twiddle those virtual knobs with our guide to music synthesisers for iPhone and iPad

How to create stunning light paintings

Get out your torches, set your camera to a long exposure and start painting in four dimensions. **Ben Pitt** trips the light fantastic



LIGHT PAINTING INVOLVES taking a photo with a long exposure time and painting light trails with a torch or some other light source. The most common example is streaks of light from photographing cars at night, but you can take the concept much further.

Light painting is an intriguing mix of photography and painting, and the process is a mixture of sculpture and performance art. Photography normally involves capturing a scene at a specific moment in time, but light painting turns that concept on its head: it condenses a period of time into an instant, capturing a subject that was never really there.

There are some superb sources of inspiration online. Search Flickr, 500px or any other photo hosting site for “light painting” and you’ll find lots of examples. One of our favourite light painters is Stephen Orlando (www.motionexposure.com), who specialises in capturing the natural movement of athletes. By attaching rows of LED lights to their arms, legs, ski poles and canoe paddles, he captures beautiful flowing motion images in stunning locations that resemble fine art sculptures.



Spinning on play equipment, 30s exposure at f/2.8, ISO 200

Darius Pearson (www.dariustwin.com) draws skeletons, animals and aliens in light, creating a glowing illustration in the middle of a scene. We love his juxtaposition of artistic landscapes and playful light paintings. His mind-blowing videos combine light painting with stop-motion and time-lapse techniques to create moving animated characters.

There are lots more examples brought together in a Creative Bloq article at tinyurl.com/bloq-lightpaint.

LIGHT SOURCES

The first thing to think about is your choice of lights. Any torch will do, but there are lots of other things you could try. A mobile phone’s flash light makes a sharp point source, and you could use a phone or tablet’s screen too. Bicycle lights are handy because they can be attached to bicycles, producing elegant curved lines as the bike cuts through the scene. Head torches and any other wearable lights work well, too.

The kids’ toy box or a toy shop can also be a useful resource. There’s no shortage of battery-powered toys with multicoloured lights. Flashing lights will create dotted lines, and objects with more than one light produce parallel lines. That can help convey a sense of perspective, with the lines converging as the source gets further away.

We stocked up on toys and novelty items for our attempts. We bought a lightsaber that has six colour modes, including the ability to cycle slowly through the colour spectrum. LED gloves with glowing fingertips are apparently designed for raves, and they’re just the thing for light painting too. We also

bought three metres of electroluminescent (EL) wire. We were initially disappointed by the low brightness of this wire, but it turned out to be ideal for creating delicate wisps of light. The wire could also be wrapped around or fastened to other objects. The lightsaber, gloves and wire came to £25 from Amazon.

A tripod is essential for any long-exposure photography. We packed our flashgun, which meant we could fill in the scenery or backlight people to create sharp silhouettes among the swirls of light. We brought string, scissors and tape – essential items for any DIY art project.

Unless you want to appear in the scene yourself, it’s best to wear dark colours. If you keep moving it’s unlikely you’ll appear at all in a 30-second exposure. Even so, a dark shadow is less noticeable than a brightly coloured smudge, especially considering you’ll be shooting at night with a dark background.

We found that walking boots or wellies are a good idea when you’re stomping around in the park after dark. You’ll probably want to bring a friend too. It’s easier with someone to control the camera and another performing with the lights. Our thanks to Toby Preston for his help in preparing this article.

CAMERA SETTINGS

You can create light paintings with any camera that allows for a long exposure. Many compact cameras have a Starry Night or similar scene preset that may do the job. There are various apps for smartphones, too – we’ll return to that subject in another issue.

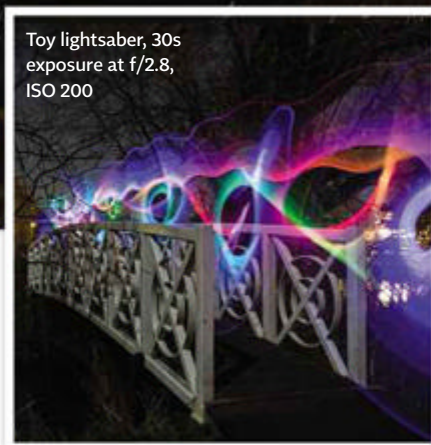
You’ll find it much easier to control the result if your camera allows manual exposure settings and Raw capture. That way you can



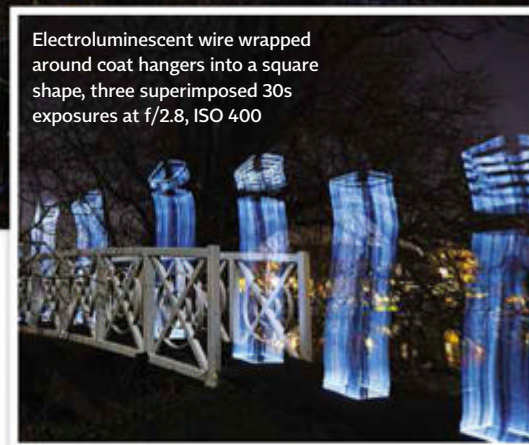
Backlit with electroluminescent wire, 30s exposure at f/7.1, ISO 160



LED gloves and a toy lightsaber, 30s exposure at f/4, ISO 200



Toy lightsaber, 30s exposure at f/2.8, ISO 200



Electroluminescent wire wrapped around coat hangers into a square shape, three superimposed 30s exposures at f/2.8, ISO 400

control the relative brightness of the light painting and the surrounding scene, and the Raw file will let you make radical adjustments in editing software.

Most cameras struggle to autofocus in very low light, so it's best to focus manually. Position your light source in the centre of the scene and use it as your focus point. White balance is tricky, especially if there's a range of light sources. The moon gives off a cool light, whereas street lamps tend to be much warmer in colour. Lights in your light painting will most likely be different again. There's no right or wrong answer here, but shooting Raw means you can delay the decision until later. If you're shooting JPEGs, try a few white balance presets to see what works best.

As always, the overall exposure is dependent on the amount of light in the scene, the ISO speed, shutter speed and aperture. For light painting, you'll need to be proactive in how you coordinate these.

Long exposures tend to be more susceptible to noise, so it's best to keep the ISO speed at its minimum value. The aperture will determine how bright the light trails appear in the image. It's best to avoid overexposing them as you'll lose any colour information, so you may need to run some tests with the lights you plan to use at

different aperture values. The brightness of the light trails also depends on how quickly you move the lights, so there's a fair bit of scope to make the trails appear stronger or weaker in different parts of the frame.

The shutter speed defines how long you've got to create your light painting performance. However, you can always turn the light off if you want to capture a longer exposure for the rest of the scene. Conversely, if your camera's maximum shutter speed isn't long enough, you could create your light performance in multiple passes and combine the images in software. This is how we created our columns of light on the bridge (above right).

Most cameras' longest shutter speed is 30 or 60 seconds, but if the camera has a bulb mode setting you can achieve longer exposure times. Bulb mode means the shutter stays open for as long as the shutter button is held down. Physically pressing the button is quite tedious, though, and there's a fair chance of

shaking the tripod. If your camera has a wired remote input, that can make life easier. We used a Triggertrap cable and smartphone app (see *App Creative, Shopper 324*), which are available for various camera brands and cost £23 from triggertrap.com.

Together, the ISO speed, aperture and shutter speed will also define how bright the rest of the scene appears. Sometimes you may only want to capture the light painting itself, but in many cases you'll want to capture the environment too. This becomes a balancing act of aperture, shutter speed and the speed at which the light sources move. Experimentation is the way forward. Use the camera's histogram display to identify when highlights have been clipped.

COMPOSING YOUR SCENE

For us, the most interesting light paintings are often the ones where the light trails interact with the environment. Perhaps they follow the contours of objects in the scene, or create shapes that complement and create a dialogue with physical objects. Depending on the type of lights you're using, you may also find that they illuminate the scene itself as well as creating light trails.

These kinds of considerations provide a vast amount of creative scope. If you start with a night scene that would stand up in its own right, and then embellish it with light trails that interact with the scene, the result can be greater than the sum of its parts.

We also really like light paintings that convey a sense of motion. Our LED gloves were great for this, as they let us move around unimpeded and their bright output showed up clearly even when moving at speed. The jogging image (left) is our favourite example of this, with flowing, swirling lines hovering above the path.



Jogging wearing LED gloves, 30s exposure at f/2.8, ISO 200

The complex pattern of loops across the bridge (opposite, centre) was created with the lightsaber, performing various sword swoops and lunges. The more even loops (opposite, top) were created by performing windmill motions with the lightsaber while walking over the bridge, with the LED gloves thrown in for good measure. Reflections in water can work particularly well, especially if the water is moving. The reflections of the light source are momentary and so take on a rippled pattern, whereas the rest of the water is smoothed out into a silky sheen by the long exposure.

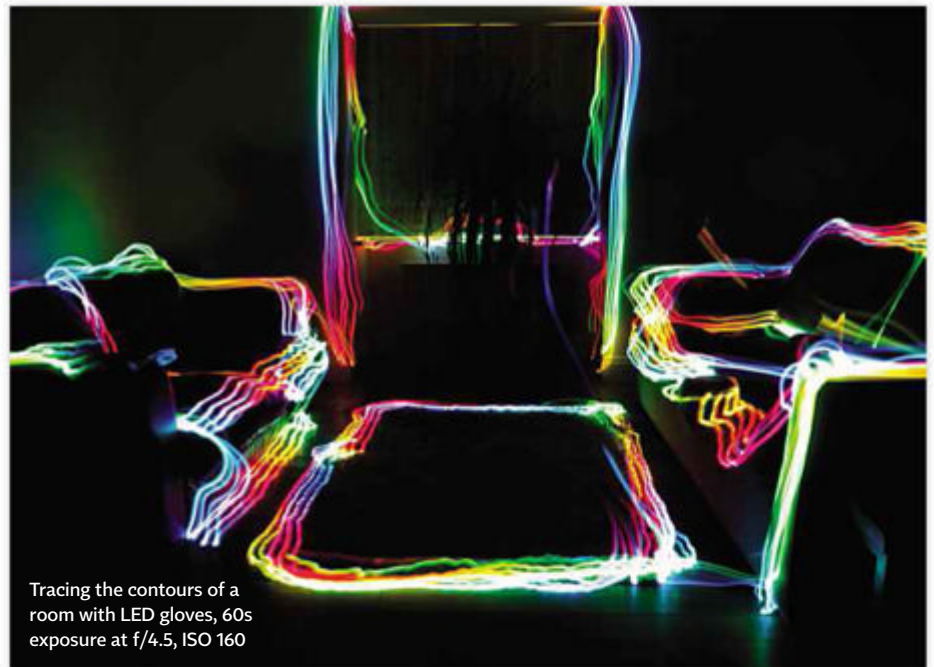
Light painting can work surprisingly well for portraits, too. We found that it's best to back- and side-light subjects, as too much light on the front just obliterates their features. Front-lighting subjects can work too, though, if you keep the lights close to the shape of the person – giving the impression of a human-shaped light source. Tracing the outlines of objects creates a 3D line drawing of the scene. Our living room furniture (right) isn't the most riveting scene to capture but it shows the potential of the technique.

POST PROCESSING

If you've captured in Raw format, there's scope to maximise the impact of your photos. We used Lightroom 5 but various other Raw editors can achieve similar results.

Lightroom's exposure controls – Blacks, Shadows, Highlight, Whites – are useful for manipulating the light painting's exposure compared to the background scene. We could make the background virtually disappear into darkness, or to look light daylight, while still keeping the integrity of the light painting.

Lightroom's ability to apply different white balance settings to different parts of the image came in very handy for the shots we captured in the park, which had a mixture of street lights and moonlight. The white balance



Tracing the contours of a room with LED gloves, 60s exposure at f/4.5, ISO 160

controls also let us make the blue electroluminescent wire appear to be white for our portrait shot. Because this was the only light source in the scene, using the white balance picker tool turned the wires white and simultaneously gave a correct white balance for the skin tones and clothing.

Check the noise reduction and sharpening

There's a huge range of possibilities in terms of light sources. You could employ bicycles, buggies or wheelchairs to produce smooth motion, perhaps placing lights as low as possible so they illuminate the ground. Visit www.light-paint.com and go to the Read section to see how artist Andy Kay created perfect domes of light by attaching LEDs to a

You could employ bicycles, buggies or wheelchairs to produce smooth motion, perhaps placing lights as low as possible so they illuminate the ground

settings before export. Some cameras – particularly those with smaller sensors – tend to be fairly noisy for long exposures, even at the slowest ISO speed. Applying heavy noise reduction can give a plastic-like gloss to the light trails that can actually be quite flattering.

One thing Lightroom can't do is combine multiple photos, so we exported to Photoshop Elements and stacked three photos together to create our blue columns image. Switching the upper two layers' Blend Mode to Lighten meant that only the brighter parts of these layers were visible – and that meant the columns of light. It also meant the stars appeared three times due to the rotation of the Earth, so we deleted the upper layers in the sky to give only one instance of the stars.


TAKING IT FURTHER

Combining multiple exposures opens up all sorts of other techniques. You might create a light painting performance in one pass, illuminate parts of the scene in another and get a perfect exposure of the background in another. Some people might consider this cheating, but we'll leave this to you to decide.

bicycle wheel on a stick. There are lots of other tips, too, such as using a tablet with an image on the screen that creates a highly specific colour and texture to the light trails.

Sparklers are popular for light painting, and some people take it a stage further by burning steel wool held inside a kitchen whisk. This sounds a bit dangerous so we don't recommend it, but there's no denying that the results are impressive.

You could capture a light painting with two cameras to create a 3D image. Because light paintings often hover in mid-air they tend to lose their sense of 3D shape, but capturing a stereo image would bring out the sense of depth.

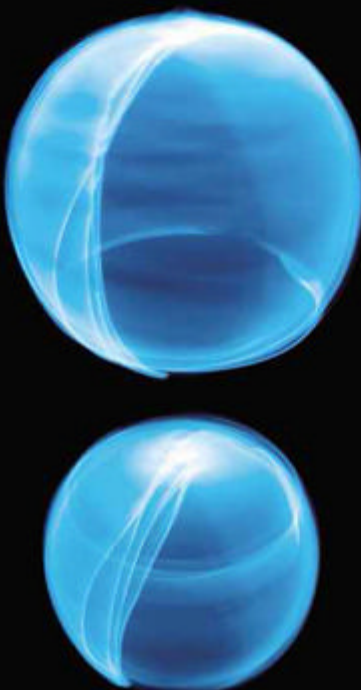
The possibilities are huge, and we suspect this is a topic we'll be returning to again in *Multimedia Expert*. 

NEXT MONTH

VIDEO FAKES

Capture outlandish stunts on video with a bit of help from your computer

Electroluminescent wire wrapped around a cake tin, spinning over a mirror, 8s exposure at f/7.1, ISO 160



Zygote

If you're wondering what that bad smell is, it's coming from **Zygote's** pocket. Hopefully whatever it is will keep the flesh-eating household appliances at bay

FISHY BUSINESS

Solar panels use a system known as quantum dots, and up until now these useful devices have been based on the platinum group of elements and coated on to zinc oxide.

Quantum dots are of huge interest for portable devices, because they release a lot more energy than normal photo-voltaic solar cells. But platinum is expensive and not very friendly to the environment. So let's hear it for the boffins at Queen Mary University of London, who have developed an organic alternative to platinum that uses chitin, a compound that's readily available on an industrial scale.

There's only one disadvantage in using chitin to power up your camera or smartphone as far as Zygote can tell: your pocket might pong a bit in warm weather. Chitin is made of prawns.

ICU

Edward Snowden, the American whistle-blower, is considered a traitor by some and a hero by others. As for Zygote, Snowden's revelations are simply depressing, particularly the proof that British security services regularly spy on UK citizens. And it came as no surprise when the Home Office released its innocently titled Draft Equipment Interference Code of Practice. The powers outlined in this document are not merely depressing, they are terrifying, and give spooks the power to switch on microphones and cameras remotely, in order to "facilitate surveillance activity".

Either the great British public were more preoccupied with the election, or they truly didn't care, but there was hardly a whiff of protest. So with Big Brother acting exactly as George Orwell predicted in *Nineteen Eighty-Four*, our own desktops, pads and phones can be used to film and record us without our consent. Maybe terrorists, paedophiles and drug dealers won't be able to

figure out how to pop a blob of Blu Tack over the camera lens and set the microphone to record Kiss FM, but Zygote suspects they're not quite as complacent as the rest of us.

GRIN AND BEAR IT

NatWest and RBS have excellent news for bank-robbers with a sweet tooth. Customers can now access their accounts using Apple's Touch ID fingerprint recognition on an iPhone.

Seven and a half million account holders already use these banks' mobile apps, and almost two million of those are proud iPhone owners who log on to NatWest and RBS an average of 40 times a month.

So, let's say farewell to all those tedious passwords, and say hello to the return of the Great Gummi Bear Hack Attack. That's right folks, instead of holding up the bank at gunpoint, today's hi-tech heist meister can clone any fingerprint using nothing more than a pliable jelly sweet, and then fool a nicked iPhone into thinking it's the real thing. A positive step forward in the health and safety of bank employees, and only a slight risk of tooth decay for the crooks.

ALT DELETE

With more and more governments insisting that communications data is stored in order to fight crime and

terrorism, the mighty Microsoft has just changed its policy on deleting user files.

In the past, files in the Deleted Items folder of utilities such as Office 365 would automatically disappear after 90 days. This is no longer so. Microsoft claims that to avoid "accidental deletions" of emails in Exchange Online, these will now be kept not for 90 days, but, believe it or not, forever!

Zygote wonders if the legal compliance motivation for this change is something of a smokescreen. After all, a huge number of Office 365 business bundles include a 50GB storage limitation. So storing memory-hungry attachments forever is going to become a very costly business indeed.

BRAIN DAMAGES

Three years ago LinkedIn, the social network for aspiring capitalists, managed to leak millions of user details to a Russian website. This resulted in 800,000 American subscribers filing a class action for damages which has only just been settled.

Following the judgment, the aggrieved claimants now need to attest they were "influenced by LinkedIn's statements in its Privacy Policy", and they will be handed their share of the loot awarded by the courts.

Zygote notes with great interest how much the private

details of these would-be captains of industry has been valued at, especially since LinkedIn's annual revenues are up by a massive 44 per cent year on year, and amount to something in the region of £1435 million. The amount of damages awarded per head? Ninety-eight pence.

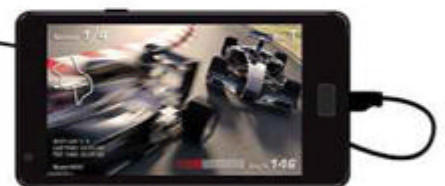
SO LONG, SUCKER

Disturbing news from South Korea on the Rise of the Robots. The latest attack by a homicidal machine on a defenceless human seems to have taken her somewhat by surprise.

Firefighters arrived at the home of a 52-year-old housewife in the city of Changwon after a frantic phone call saying that a computer-controlled vacuum cleaner was attempting to eat her after she had fallen asleep on the floor. Mistaking her hair for dust, the robot began to devour her from the top down, but fortunately she was rescued before any lethal damage had been done.

Zygote notes there are more than 10 million autonomous vacuum cleaner robots on the loose, capable of seeking out power sockets and charging themselves at will before going on the hunt for human victims. Zygote advises you to remember that the process of computing is still measured in bytes. You have been warned. ☹



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